

Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS)

5-Year Experience Study

July 1, 2012 Through June 30, 2017



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February 6, 2018

Retirement Board
Missouri Department of Transportation
and Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, Missouri 65102-1930

Dear Board Members:

Presented in this report are the results of an Experience Study of Missouri Department of Transportation and Highway Patrol Employees' Retirement System (MPERS). The Study was conducted for the purpose of reviewing and, where necessary, updating the assumptions used in the actuarial valuation model.

The investigation was based upon the statistical data furnished for annual active member and retired life actuarial valuations during the period **July 1, 2012 to June 30, 2017**. A file-matching technique was utilized to track individual member activity from one year to the next.

This report is divided into the following sections:

- A) Background
 - The actuarial valuation model and the need for actuarial assumptions
 - A sensitive model – why assumptions need to be reviewed
- B) Comments and Recommendations
- C) Economic Activity
 - Inflation and Real Wage Growth
 - Investment Return
- D) Active Decrement Activity – Actual vs. Expected
 - Withdrawals
 - Disability
 - Retirement
 - Merit and Longevity Wage Increases
 - Pre-Retirement Mortality
- E) Post-Retirement Mortality
- F) Actuarial Methods and Miscellaneous and Technical Assumptions
- G) Comprehensive Listing of Demographic Assumptions

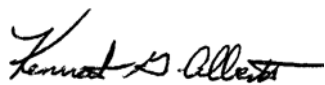
To the best of our knowledge, the report is complete and accurate and was conducted in accordance with the standards of practice promulgated by the Actuarial Standards Board. We believe that the recommended actuarial assumptions contained in this report will produce valuation results which, in the aggregate, are reasonable and in compliance with local, State and federal laws.

This report should not be relied on for any purpose other than that described above. It was prepared at the request of the Board and is intended for use by the Board and those designated or approved by the Board. This report may be provided to parties other than the Board only in its entirety and only with the permission of the Board. GRS is not responsible for unauthorized use of this report.

The signing individuals are independent of the plan sponsor.

Heidi G. Barry is a Member of the American Academy of Actuaries (MAAA) and meets the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.

Respectfully submitted,



Kenneth G. Alberts



Heidi G. Barry, ASA, FCA, MAAA

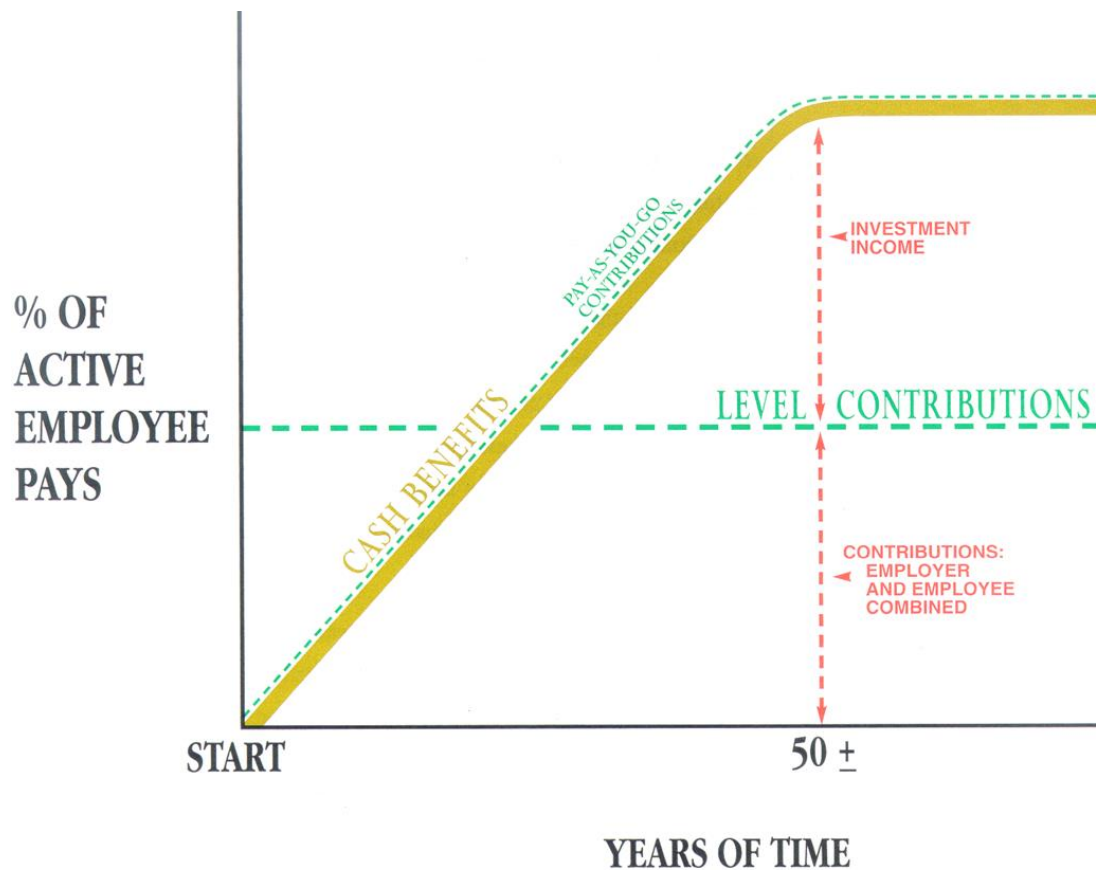
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SECTION A

BACKGROUND

The Actuarial Valuation Model and the Need for Actuarial Assumptions



When a pension plan is first implemented the cash demands are nil because there are no retired members. As the plan ages, the cash demands begin to grow as more and more members retire. If a plan follows the pay-as-you-go principle, the following will happen (see illustration above):

- Cash contributions will slightly exceed the cash benefits (because of administrative expenses).
- Contributions will start very low and continue to escalate as a percent of active member payroll until the plan matures, generally over a period of 50 or more years.
- Benefits currently accruing will become a financial obligation for future generations.
- The entire cost of the benefits currently accruing will be paid in the future.

The Actuarial Valuation Model and the Need for Actuarial Assumptions

Many plans, including MPERS, finance their obligations in a different manner: Pre-funding with level percent of payroll contributions (illustrated by the level line in the graph on the previous page). Under this arrangement the following is expected to occur:

- Cash contributions exceed cash demands in the early years of a plan, thereby building a pool of assets.
- The pool of assets generates investment income which will ultimately pay for a significant portion of the benefit obligation.
- Contributions are able to remain approximately level (as a percent of payroll) creating intergenerational equity.
- Cash demand (or benefit payments) will ultimately exceed the employer and employee contributions (the difference is paid for by investment income on the pool of assets).

The key to this second financing arrangement is the level percent of payroll contribution. This contribution is computed by the means of an actuarial valuation which is essentially a mathematical model. The mathematical model is necessary in a defined benefit plan because there are “knowns” and “unknowns” which must be evaluated before the level contribution rate can be determined.

The “knowns” are:

- Participants in the plan.
- The demographic characteristics of each active and inactive member (i.e., age, sex, salary, service, etc.).
- The demographic characteristics of each retired member and beneficiary (i.e., age, sex, benefit, form of payment, etc.).
- The conditions and characteristics of the plan (i.e., type and amount of benefits payable, eligibility for benefits, length of time benefit is payable, etc.).
- The current purchasing power of a dollar.
- The value of the pool of assets.
- How the pool of assets is invested.

The Actuarial Valuation Model and the Need for Actuarial Assumptions

The “unknowns” are:

- Who will retire and at what age, service and final average earnings?
- Who will quit before becoming vested?
- Who will quit and be entitled to a future vested benefit?
- Who will become disabled?
- How long will members and their beneficiaries live (before and after retirement)?
- What is the future purchasing power of the dollar (future inflation)?
- How much income will the pool of assets generate?

The valuation model takes the “knowns,” incorporates assumptions about the “unknowns” and develops the estimated cost of the plan for the current members. This cost is then financed using an actuarial cost method to determine the level contribution requirement.

Because future experience cannot be predicted with certainty, the costs can only be estimated. The model is revisited annually to re-determine the cost estimates based upon experience which has already occurred and assumptions about future experience.

A Sensitive Model – Why Assumptions Need to Be Reviewed

When System experience deviates from expected experience, a gain or loss is generated. This gain or loss is then amortized over a period of future years and applied as an offset or addition to the normal cost contribution. Over time, it is expected that the gains and losses will offset each other. If they do not, then one or more of the actuarial assumptions may need to be modified to reflect actual emerging experience.

If the assumptions are too conservative (the estimated cost of the plan is too high) then the computed contribution rate will decrease over time. If the assumptions are too liberal (the estimated cost of the plan is too low) then the computed contribution rate will increase over time. In either case, this is not consistent with the level percent of payroll principle to establish contributions that will, over time, remain approximately level as a percent of payroll.

In addition, *each* assumption should represent a reasonable estimate of future experience. Even though a package of assumptions may produce results which are reasonable, it is important that each component of the package reflect actual expected experience. Estimated costs of benefit changes, for example, are highly dependent upon specific assumptions.

The actuarial assumptions are intended to be the best estimate of future experience of the System when they are adopted, but conditions change over time. In addition, our understanding of the conditions affecting plan activity changes (even if the conditions themselves are not changing). It is for these reasons, and the desire to keep the computed contribution rate as level as possible, that the actuarial assumptions should be reviewed periodically and adjusted to reflect basic experience trends -- **but not random year-to-year fluctuations.**

Selecting Demographic Assumptions

Guidance regarding the selection of demographic assumptions for measuring pension obligations is provided by Actuarial Standards of Practice (ASOP) No. 35. The standard requires that the selected demographic assumptions be reasonable reflections of future experience. While past demographic experience is generally a good indicator of future demographic experience, the ASOP cautions the actuary not to give undue weight to past experience or experience that is not sufficiently credible.

ASOP No. 35 defines a reasonable demographic assumption in section 3.3.5 of the standard. That section is replicated below:

3.3.5 Select a Reasonable Assumption—Each demographic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

- a) It is appropriate for the purpose of the measurement;
- b) It reflects the actuary's professional judgment;
- c) It takes into account historical and current demographic data that is relevant as of the measurement date;
- d) It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data (if any), or a combination thereof; and
- e) It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included (as discussed in section 3.10.1) and disclosed under section 4.1.1 or when alternative assumptions are used for the assessment of risk.

Selecting Economic Assumptions

Guidance regarding the selection of economic assumptions for measuring pension obligations is provided by Actuarial Standards of Practice (ASOP) No. 27. The standard requires that the selected economic assumptions be consistent with each other. That is, the selection of the investment return assumption should be consistent with the selection of the wage inflation and price inflation assumptions.

ASOP No. 27 defines a reasonable economic assumption in section 3.6. This section is replicated below:

3.6 Selecting a Reasonable Assumption—Each economic assumption selected by the actuary should be reasonable. For this purpose, an assumption is reasonable if it has the following characteristics:

- a) It is appropriate for the purpose of the measurement;
- b) It reflects the actuary's professional judgment;
- c) It takes into account historical and current economic data that is relevant as of the measurement date;
- d) It reflects the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof; and
- e) It has no significant bias (i.e., it is not significantly optimistic or pessimistic), except when provisions for adverse deviation or plan provisions that are difficult to measure are included and disclosed under section 3.5.1, or when alternative assumptions are used for the assessment of risk.

3.6.1 Reasonable Assumption Based on Future Experience or Market Data—The actuary should develop a reasonable economic assumption based on the actuary's estimate of future experience, the actuary's observation of the estimates inherent in market data, or a combination thereof. Examples of how the actuary may observe estimates inherent in market data include the following:

- a) comparing yields on inflation-indexed bonds to yields on equivalent non-inflation-indexed bonds as a part of estimating the market's expectation of future inflation;
- b) comparing yields on bonds of different credit quality to determine market credit spreads;
- c) observing yields on U.S. Treasury debt of various maturities to determine a yield curve free of credit risk; and
- d) examining annuity prices to estimate the market price to settle pension obligations.

The items listed above, as well as other market observations or prices, include estimates of future experience as well as other considerations. For example, the difference in yields between inflation-linked and non-inflation-linked bonds may include premiums for liquidity and future inflation risk in addition to an estimate of future inflation. The actuary may want to adjust estimates based on observations to reflect the various risk premiums and other factors (such as supply and demand for tradable bond or debt securities) that might be reflected in market pricing.

3.6.2 Range of Reasonable Assumptions—The actuary should recognize the uncertain nature of the items for which assumptions are selected and, as a result, may consider several different assumptions reasonable for a given measurement. The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice.

SECTION B

COMMENTS AND RECOMMENDATIONS

Summary of Findings Non-Uniformed

Description	Current Experience Study			Last Experience Study
	General Direction of Change in Rates	General Direction of Long-Term Cost Change	General Direction of Short-Term Employer Contribution Change	General Direction of Change in Rates
Age-based withdrawal (5 or more years of service)	Increase	Decrease	Decrease	Increase for males. Neutral for females.
Service-based withdrawal (less than 5 years of service)	Neutral for males. Increase for females.	Decrease	Increase*	Increase
Disability	Increase	Increase	Increase	Increase
Normal retirement	Decrease for males. Neutral for females.	Decrease	Decrease	Increase for males. Neutral for females.
Early (reduced) retirement	Decrease for males. Increase for females.	Decrease Increase	Decrease Increase	Decrease
Healthy Post-retirement mortality	Neutral	Neutral	Neutral	Decrease for males. Increase for females.
Disabled mortality	Decrease	Decrease	Decrease	Neutral
Pre-retirement mortality	Increase	Increase	Increase	Decrease
Merit and seniority pay increases	Decrease	Decrease	Decrease	Decrease

* Note that the change in the short term contributions can move in a different direction than the change in the long term cost, in certain circumstances. This can happen if rates (such as rates of termination and pay) are lowered for periods early in members careers, but most of the current active members are currently past those periods.

Summary of Findings Uniformed

Description	Current Experience Study			Last Experience Study
	General Direction of Change in Rates	General Direction of Long-Term Cost Change	General Direction of Short-Term Employer Contribution Change	General Direction of Change in Rates
Age-based withdrawal (5 or more years of service)	Decrease	Increase	Increase	Decrease
Service-based withdrawal (less than 5 years of service)	Decrease	Increase	Decrease*	Decrease
Disability	Increase	Increase	Increase	Neutral
Normal retirement	Increase	Increase	Increase	Decrease
Healthy Post-retirement mortality	Neutral	Neutral	Neutral	Decrease for males. Increase for females.
Disabled mortality	Decrease	Decrease	Decrease	Neutral
Pre-retirement mortality	Increase	Increase	Increase	Decrease
Merit and seniority pay increases	Decrease	Decrease	Decrease	Decrease

* Note that the change in the short term contributions can move in a different direction than the change in the long term cost, in certain circumstances. This can happen if rates (such as rates of termination and pay) are lowered for periods early in members careers, but most of the current active members are currently past those periods.

Summary of Decrement Assumptions

Background: In general, recent patterns of non-economic activity (rates of withdrawal, disability, death, retirement, and merit and seniority pay increases) tend to be reliable predictors of future experience. However, past activity will also contain anomalies (or special circumstances) that cannot be assumed to replicate in the future. The actuary attempts to identify and remove these anomalies before creating recommended rates. The goal is to identify long-term trends in activity and move the rates toward those trends as a result of the periodic investigations. In establishing our recommendations, we have considered the results of the prior study, as well as the observed trends from this study.

Experience was studied separately for Uniformed members and Non-Uniformed members. For the Non-Uniformed members, the experience was further broken down between male and female members. Male and female experience was studied in aggregate for the Uniformed group since it is over 95% male.

Our first step was to look at liability gains and losses over the measurement period. The table below suggests that the current set of assumptions has generated small liability gains over all during the measurement period. Therefore we should expect that recommended demographic changes will be small and generally in the direction of lowering long-term costs.

Liability Gain/(Loss) for Year				Percent of Beginning of Year Liability
	Non-Uniform	Uniform	Total	
2016/2017	\$ 31,092,516	\$ 5,026,227	\$ 36,118,743	1.0%
2015/2016	19,071,903	14,534,045	33,605,948	0.9%
2014/2015	37,247,221	(24,363,050)	12,884,171	0.4%
2013/2014	17,448,551	(1,461,202)	15,987,349	0.4%
2012/2013	4,346,941	7,616,019	11,962,960	0.4%
Total	\$ 109,207,132	\$ 1,352,039	\$ 110,559,171	

Rates of Withdrawals: Withdrawals from service were studied separately for members with less than five years of service and members with five or more years of service. Actual experience was below expectations for Uniformed members and above expectations for Non-Uniformed members. The rates were adjusted to more closely track experience.

Disability: Observed rates of disability are higher than assumed for Uniformed and Non-Uniformed members. The recommended rates were increased for Uniformed and Non-Uniformed members to more closely track experience.

Normal Retirement: Actual experience was above expectations for Uniformed members and below expectations for Non-Uniformed members. Rates were adjusted accordingly to more closely track experience.

Early Retirement: Experience indicated fewer early retirements than assumed for males and more than assumed for females. The recommended rates were adjusted accordingly.

Summary of Decrement Assumptions (Concluded)

Post-Retirement Healthy Mortality Rates are used to measure the probabilities of members dying after retirement. The rates currently in use are from the RP-2000 Mortality Table projected 16 years and set back 1 year for males and females. We recommend these tables be updated to the RP-2014 Healthy Annuitant Mortality Table projected to 2022 using projection scale MP-2017. These are the newest tables and projection scales released by the Society of Actuaries and better account for the mortality improvements of coming generations.

Post-Retirement Disabled Mortality Rates. The rates currently in use for disabled lives are from the PBGC Disabled Mortality Tables. We recommend these tables be updated to the RP-2014 Disabled Retiree Annuitant Mortality Tables projected to 2022 using projection scale MP-2017.

Pre-Retirement Mortality Rates. The rates currently in use for active lives are the same as the rates for Post-Retirement Mortality except multiplied by a factor of 70% for males and 50% for females. We recommend these tables be updated to the RP-2014 Employee Mortality Table projected to 2022 using projection scale MP-2017 and multiplied by a factor of 65%.

More detail concerning proposed mortality assumptions can be found on pages **D-22, D-23** and in **Section E**.

Pay Increase Rate (Merit and Longevity Portion) was analyzed to see if the correlation with service was stronger than the correlation with age. The correlation with service was stronger than the correlation with age. Therefore, the rates were adjusted to only use service based rates.

Complete listings of all assumptions are in Sections F and G.

Summary of Decrement Experience

Aggregate Summary of Active Decrements Experienced Between 2012 and 2017

Decrement Risk Area	Actual	Expected	
		Present	Proposed
<u>Withdrawal - Total</u>			
Uniform	77	102	81
Non-Uniform			
Male	1,252	1,016	1,113
Female	421	308	380
<u>Withdrawal - Service 5 & Up</u>			
Uniform	37	56	38
Non-Uniform			
Male	579	380	477
Female	248	148	218
<u>Disability</u>			
Uniform	8	3	6
Non-Uniform	89	65	76
<u>Normal Retirement</u>			
Uniform	144	136	144
Non-Uniform			
Male	827	845	837
Female	297	307	307
<u>Early Retirement</u>			
Non-Uniform			
Male	62	69	68
Female	25	21	24
<u>Mortality - Retired Lives</u>			
Healthy Lives			
Male	865	728	725
Female	61	65	67
<u>Mortality - Active Lives</u>			
Male	23	26	26
Female	3	4	4
<u>Mortality - Disabled Lives</u>			
Male	22	36	21
Female	7	7	3

Active Member Data Reconciliation

Uniformed Members

Valuation Year	Active Members Beginning of Year	Retired	Disabled	Died	Vested Terminated	Non-Vested Terminated	New	Active Members End of Year
2013	1,215	21	1	1	8	4	39	1,219
2014	1,219	35	1	1	1	6	62	1,237
2015	1,237	34	3	0	10	9	63	1,244
2016	1,244	20	1	1	5	14	51	1,254
2017	1,254	34	2	0	6	14	66	1,264
2018	1,264							
5-year	1,215	144	8	3	30	47	281	1,264
Expected		136	3	4	56	46		

Non-Uniformed Members

Valuation Year	Active Members Beginning of Year	Retired	Disabled	Died	Vested Terminated	Non-Vested Terminated	New	Active Members End of Year
2013	6,243	314	22	6	205	102	506	6,100
2014	6,100	208	15	5	136	157	574	6,153
2015	6,153	291	17	2	167	202	640	6,114
2016	6,114	192	16	6	127	219	633	6,187
2017	6,187	206	19	4	102	256	592	6,192
2018	6,192							
5-year	6,243	1,211	89	23	737	936	2,945	6,192
Expected		1,242	64	26	528	796		

Economic Recommendations

Economic Assumptions. When it comes to economic assumptions, there is no best single combination of assumptions. We are guided by the Actuarial Standards of Practice in developing recommendations we believe to be reasonable. We believe that the current set of economic assumptions (7.75% interest; 3.50% wage inflation) was reasonable for the 2017 and earlier valuations, however; current economic trends as well as future expectations indicate these assumptions should be lowered for the 2018 and future valuations. Based on a forward-looking approach, using the average capital market assumptions of eight investment consultants, the current assumptions appear to be more aggressive than average. More detail on the analysis of the current assumption using capital market assumption models can be found on **pages C-7 and C-8**.

The current wage inflation assumption, while not unreasonable, does not appear to reflect recent trends in yearly changes in CPI. We suggest lowering the wage inflation (and price inflation) assumption for future years. Further information on recent trends regarding inflation can be found on **pages C-1 through C-5**.

Administrative expenses are currently added as a load to the normal cost. The load is based on actual administrative expenses for the preceding year. We do not recommend a change to this method.

The credited interest on member contributions is currently assumed to be 4.0%. We recommend lowering this assumption to 3.0%.

Given past experience and current economic trends, we recommend the following sets of alternative assumptions be taken into consideration:

	Current Assumptions	Alternatives			
		(1)	(2)	(3)	(4)
Investment Return	7.75%	7.25%	7.00%	7.00%	6.75%
Wage Inflation	3.50%	3.00%	3.00%	3.00%	2.75%
Real Rate of Return (over wage)	4.25%	4.25%	4.00%	4.00%	4.00%
Price Inflation	3.00%	2.50%	2.50%	2.25%	2.25%
Real Rate of Return (over price)	4.75%	4.75%	4.50%	4.75%	4.50%

Other Recommendations

Actuarial Value of Assets: The funding value of assets is currently 100.14% of the market value. The funding value of assets is currently set to recognize \$23 million in prior deferred losses for the 2018 valuation followed by \$20 million in prior deferred gains in the 2019 valuation. Since the deferred losses are approximately equal to the deferred gains, we recommend the Board consider resetting the funding value of assets to the market value for the next valuation.

Load for unused sick leave: Currently Normal and Early retirement benefits for Closed and Year 2000 Plans are increased by 3.0% for Uniformed members and 2.6% for Non-Uniformed members to account for the inclusion of unused sick leave in the calculation of Average Pay. The table below is based on the members who have retired over the last 5 years:

Member Group	Number	Average Service Years	Average Unused Sick Leave Years*	Ratio
Uniformed	144	28.5	1.32	4.64%
MoDOT	985	23.5	0.60	2.56%
Civilian Patrol	226	21.3	0.54	2.54%

** Based on crediting 1 month of service for every 168 hours of unused sick leave.*

We do not think that it is appropriate to give full credibility to the sick leave experience in the past 5 years, since results are so dramatically different than the prior two experience studies for Uniformed members. Based on our review, we recommend that the load for unused sick leave for Uniformed members of the Closed and Year 2000 plans be increased to 3.75%. This review supports continued use of the current loads for Non-Uniformed members of the Closed and Year 2000 Plans at the current assumption of 2.6%. Year 2011 Tier Normal and Early retirement benefits are increased by 1.5% for Uniformed members and 1.0% for Non-Uniformed members to account for the inclusion of unused sick leave in the calculation of Average Pay. We recommend that the loads be continued until sufficient experience emerges to study this group in detail.

Load for end of career increases in compensation: Additionally we have looked into the load for end of career increases in compensation. There is currently no load for this activity. In past experience studies, it was determined that this activity does not occur with any frequency that would merit modeling in the valuation. For this experience study, we looked at the expected versus actual new retiree liabilities in the past 5 years. The table below shows the aggregate results. The table above indicates that new retiree benefits have generally been lower than expected. As a result, we do not believe that a load for end of career increases in compensation is necessary.

(\$ millions)		
Group	Expected Reserve Transfer	Actual Reserve Transfer
Uniformed	\$146.0	\$143.6
Non-Uniformed	\$412.9	\$399.8

Optional forms of payment: Reduction factors for the Y2K plan are codified in the statute. Factors for the closed plan are adopted by the Board. We reviewed these factors and find them to be actuarially equivalent within reasonable tolerances, based on the current economic assumptions. These factors will get reviewed one final time after the Board formally adopts a new set of economic assumptions and a load may be added, if warranted. Such a load is not expected to be greater than 1% -2% for the alternate economic assumptions included in this study.

Other Recommendations

Marriage Assumption: The current assumption is that 90% of active members are married for the death-in-service benefit. It is also assumed that 100% of future Closed plan retirees are married for the automatic 50% survivor benefit. These assumptions continue to appear reasonable and we recommend no change to them. In order to better evaluate the assumption that 90% of active members are married for the death-in-service benefit, it would be useful to receive information on all members that have terminated active status and the reason for doing so.

Deferred and Active members eligible for Closed and Y2K plan benefits: Closed plan members are able to elect Y2K benefits at retirement. We assume they will elect a Closed plan benefit. Although there may be increases or decreases in liabilities for individual members based on the election of Y2K benefits, in aggregate we do not believe that these elections will result in a cost to the system. We will continue to monitor the liabilities for Closed plan members and may update this assumption as experience emerges.

Load for potential survivor benefits of future disabled members: We currently increase the liabilities for future disabled members by 50% to account for survivor benefits for members that die prior to normal retirement commencement. We do not otherwise model this benefit for future disabled members. We recommend no change to this assumption.

Load for survivor benefits of current self-insured disability retirants: Survivor benefits for current self-insured disability members are currently modeled by increasing the liabilities by 23%. For these members that are eligible for Y2K benefits, the average years remaining to retirement eligibility in 2012 was 4.1 years. In 2017 the self-insured disability retirants will on average become eligible for Y2K retirement in 1.3 years. As a result, we recommend that the load be lowered to 12%. Note that this is a closed group of members and the liabilities for this group are becoming less material every year.

Load for survivor benefits for future deferred members: Liabilities for future deferred members were increased by 2% to account for potential survivor benefits payable if the member dies during the deferred period. We have otherwise not modeled this benefit for future deferred members. The rationale for this load is based on the associated liabilities for the current deferred members. There is pending legislation that will eliminate this benefit for 2011 Tier participants. The load will be eliminated for 2011 Tier participants in the next valuation.

Gainful employment offset for \$90 per month special benefit: The current assumption is that 30% of the \$90 per month special benefit for future Uniformed Closed plan retirees is offset by gainful employment. This assumption is immaterial and we are not recommending a change to the assumption.

Forfeiture of deferred benefits: There is currently not enough experience to create an assumption regarding the forfeiture of deferred benefits by 2011-Tier members. These members may elect to withdraw their contributions in lieu of a future benefit. We recommend no change to the current assumption that 0% of 2011-Tier members will elect to forfeit their benefit. We will continue to monitor this assumption and may recommend changes as experience emerges. In order to assist us in determining this assumption, it would be useful if future census data included a listing of all members that have terminated employment, whether vested or not during the applicable year and the amount of the refund, if any.

Liabilities for transfers and rehires: We have studied the impact on the plan due to new liabilities from transfers and rehires. Based on the current funding policy, we do not believe that this experience has a material effect on the plan. Therefore, we are not recommending a load to account for such experience.

Valuation Results

Contribution Calculation Comparison

	Present Decrement and Present Economic Assumptions	Proposed Decrement Assumptions and				
		Present	Economic	Economic	Economic	Economic
		Economic#	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Economic Assumptions						
Investment Return	7.75 %	7.75 %	7.25 %	7.00 %	7.00 %	6.75 %
Wage Inflation	3.50 %	3.50 %	3.00 %	3.00 %	3.00 %	2.75 %
Spread on Wages	4.25 %	4.25 %	4.25 %	4.00 %	4.00 %	4.00 %
Price Inflation	3.00 %	3.00 %	2.50 %	2.50 %	2.25 %	2.25 %
COLA	2.40 %	2.40 %	2.00 %	2.00 %	1.80 %	1.80 %
Amortization Policy*						
Retired Unfunded Liabilities	7 years	7 years	7 years	7 years	7 years	7 years
Other Unfunded Liabilities	22 years	22 years	22 years	22 years	22 years	22 years
Non-Uniformed Group						
Employer Contributions for						
Normal Cost	9.96 %	8.18 %	8.52 %	9.15 %	8.99 %	9.35 %
Unfunded Actuarial Accrued Liability (UAAL)	36.23 %	35.84 %	38.40 %	41.19 %	39.05 %	42.56 %
Disability Insurance	0.53 %	0.53 %	0.53 %	0.53 %	0.53 %	0.53 %
Administrative Expenses	1.21 %	1.21 %	1.21 %	1.21 %	1.21 %	1.21 %
Total Computed Employer Contribution Without Contribution Stabilization Reserve Fund	47.93 %	45.76 %	48.66 %	52.08 %	49.78 %	53.65 %
Utilization of Contribution Stabilization Reserve Fund	10.07 %	11.73 %	9.34 %	5.92 %	8.22 %	4.35 %
Total Computed Employer Contribution With Contribution Stabilizaition Reserve Fund	58.00 %	57.49 %	58.00 %	58.00 %	58.00 %	58.00 %
Uniformed Group						
Employer Contributions for						
Normal Cost	15.98 %	15.02 %	15.62 %	16.78 %	16.54 %	17.12 %
Unfunded Actuarial Accrued Liability (UAAL)	31.84 %	31.69 %	34.43 %	36.25 %	35.12 %	38.40 %
Disability Insurance	0.53 %	0.53 %	0.53 %	0.53 %	0.53 %	0.53 %
Administrative Expenses	1.21 %	1.21 %	1.21 %	1.21 %	1.21 %	1.21 %
Total Computed Employer Contribution Without Contribution Stabilization Reserve Fund	49.56 %	48.45 %	51.79 %	54.77 %	53.40 %	57.26 %
Utilization of Contribution Stabilization Reserve Fund	8.44 %	9.04 %	6.21 %	3.23 %	4.60 %	0.74 %
Total Computed Employer Contribution With Contribution Stabilizaition Reserve Fund	58.00 %	57.49 %	58.00 %	58.00 %	58.00 %	58.00 %
MPERS Totals						
Combined Employer Contribution Rate	58.00 %	57.49 %	58.00 %	58.00 %	58.00 %	58.00 %
Projected Dollar Contributions (\$ millions)	216.8	217.3	217.1	217.1	217.1	216.0
UAAL (\$ millions)	1,629.7	1,631.3	1,721.9	1,830.0	1,775.4	1,879.5
Contribution Stabilization Reserve Fund (\$ millions)	219.6	250.0	189.6	111.9	161.3	73.3
Total Amount Financed (\$ millions)	1,849.2	1,881.3	1,911.5	1,941.9	1,936.7	1,952.8
MPERS Funded Status	57.14 %	57.12 %	55.79 %	54.28 %	55.03 %	53.62 %

Reflects proposed demographic assumptions and is for illustrative purposes only. Nominal rates of return for these alternates are outside the recommended range.

* The amortization of the UAAL under all scenarios was performed using the temporary funding policy which results in a larger combined MPERS contribution than the permanent policy after utilizing the contribution stabilization reserve fund.

Test Case Review

The chart below shows a list of activity resulting in benefit payments for members of MPERS. For this valuation we have reviewed test cases related to normal retirement. For the next experience study, we intend to review additional test cases related to a different decrement.

	Test cases reviewed for study ending in 2017
For members that are active:	
Active to normal retirement	
Active to early retirement	
Active to vested deferred	
Active non-duty death prior to retirement	
Active duty death prior to retirement	
Active to disabled	
Purchase of service	
Active transfer within MPERS (e.g. Uniform to Non-Uniform)	
Active portability (e.g. MPERS to MOSERS)	
For members that are retired	
Retired change in spouse	
Retired death after retirement	
Retired to active	
For members that are disabled	
Disabled to retired	
Disabled to active	
Disabled death prior to retirement	
For members that are vested deferred	
Vested deferred to retired	
Vested deferred death prior to retirement	
Vested deferred to active (internal)	
Vested deferred to external transfer	
Purchase of service	

For each scenario above, test cases are requested for the following, when applicable:

- Closed, Year 2000, and 2011 Tier plans
- Uniform and Non-Uniform
- For participants in the Closed plan, calculations of Year 2000 benefits
- Calculations for various forms of payments
- Active members electing BackDROP

While not a typical part of an experience study, we have added this test to the process to check for potential changes in administration or benefit conditions that may not have been identified in the annual valuation process. The intent is to look at members who have had a status change during the year and compare how we modeled that status change (before it happened) to how it actually occurred in order to identify any changes in programming that might be appropriate.

This process did not identify any needed changes in modeling this year.

SECTION C

ECONOMIC ACTIVITY

Price Inflation

We have performed our economic analysis using a building block method. This method starts with an analysis of price inflation. Once a recommended price inflation assumption is established, we then:

- 1) Add an assumption of real return to get to the nominal assumed rate of investment return; or
- 2) Add real wage growth to get to the assumed wage inflation and then add a merit and longevity increase assumption to get to the total assumed pay increases.

The table below shows the average price inflation over various periods:

Fiscal Year	Average Annual Increase in CPI-U
2013	1.75 %
2014	2.07 %
2015	0.12 %
2016	1.00 %
2017	1.63 %
3-Year Average	0.92 %
5-Year Average	1.32 %
10-Year Average	1.65 %
20-Year Average	2.15 %
25-Year Average	2.27 %
30-Year Average	2.61 %
40-Year Average	3.59 %
50-Year Average	4.11 %

As the table shows, experience, both short-term and long-term, has been below the **current assumption of 3.00%**. In addition, we can see that rates of inflation have been steadily declining over the last 30 years.

So as not to give undue weight to recent experience, we also consider future expectations. One measure is the spread between yields on U.S. Treasuries and U.S. TIPS. This calculation varies depending on the maturity selected. Moreover, there may be other influences on the result such as a risk premium on Treasuries and a liquidity premium on TIPS. We therefore also consider other sources. The TIPS analysis and a description of a few of the additional sources follows.

The June 30, 2017 yield for a 20-year inflation indexed Treasury bond (20-year TIPS) was 0.84% plus actual inflation. The yield for a non-indexed 20-year Treasury bond was 2.61%. The difference between these two yields, 1.77%, gives an approximate measure of the market's expectation of price inflation over the next 20 years.

The Philadelphia Federal Reserve conducts a quarterly survey of the Society of Professional Forecasters. Their recent forecast, from the fourth quarter of 2017, is for inflation over the following ten years to average 2.20%.

Price Inflation

We reviewed the forward-looking inflation assumptions used by the eight independent investment consulting firms that work with public sector plans. The samples from these firms ranged from 2.00% to 2.50%, with an average of 2.27%.

Another point of reference is the 2017 Social Security Trustees Report which assumed three scenarios of ultimate annual increases in CPI of 3.20%, 2.60%, and 2.00% for the low-cost, intermediate, and high-cost scenarios. The Social Security Trustees Report uses the ultimate rates for their 75-year projections, much longer than the longest horizon we can discern from Treasuries and TIPS.

The table on the following page summarizes future expectations of inflation from several sources. In every case, expectations of future inflation are below the current assumption. **When combining this analysis with the historical analysis, we recommend lowering the price inflation to a range between 2.00% and 2.50%.**

Price Inflation

Summary of Forward-Looking Compound Annual Price Inflation Forecasts (From Professional Experts in Forecasting Inflation)	
Investment Consultants and Forecasters Average of eight in 2017 GRS Survey	2.27%
Excess Yield of Nominal Treasuries Over Inflation Indexed, June 2017	
30-Year Treasury Constant Maturity – Nominal	2.84%
30-Year Treasury Constant Maturity – Inflation Indexed	0.99%
Difference (30-Year Implied Price Inflation)	1.85%
20-Year Treasury Constant Maturity – Nominal	2.61%
20-Year Treasury Constant Maturity – Inflation Indexed	0.84%
Difference (20-Year Implied Price Inflation)	1.77%
10-Year Treasury Constant Maturity – Nominal	2.31%
10-Year Treasury Constant Maturity – Inflation Indexed	0.58%
Difference (10-Year Implied Price Inflation)	1.73%
Federal Reserve Bank of Cleveland	
30-Year Expectation on July 1, 2017	2.18%
20-Year Expectation on July 1, 2017	2.04%
10-Year Expectation on July 1, 2017	1.85%
Quarterly Survey of Professional Economic Forecasters (Headline CPI) 4Q2017 Federal Reserve Bank of Philadelphia 10-Year Forecast	2.20%
Federal Reserve Board's Federal Open Market Committee Long-run Price Inflation Objective (PCE) (Since Jan 2012)	2.00%
Congressional Budget Office June 2017 report <i>An Update to The Budget and Economic Outlook: 2017 to 2027</i> 2017 to 2027 Fiscal Year CPI-U	2.36%
2017 Social Security Trustees Report	
GDP Deflator Ultimate Intermediate Assumption	2.20%
CPI-W Ultimate Intermediate Assumption	2.60%

Wage Inflation

Real Wage Growth is the increase in average salary levels in excess of pure price inflation (i.e., increases due to changes in productivity levels, supply and demand in the labor market and other macroeconomic factors).

We are generally comfortable with the wage inflation assumption exceeding the price inflation assumption by 0.50% to 1.25%.

The table below shows the difference between the increase in National Average Earnings and price inflation over various periods, ending December 2016:

Periods Ending December 2016	Difference Between Increase in National Average Earnings and CPI
Last five (5) years	1.3%
Last ten (10) years	0.6
Last fifteen (15) years	0.6
Last twenty (20) years	1.1
Last twenty-five (25) years	1.0
Last thirty (30) years	0.9

Historical Patterns of Investment Return

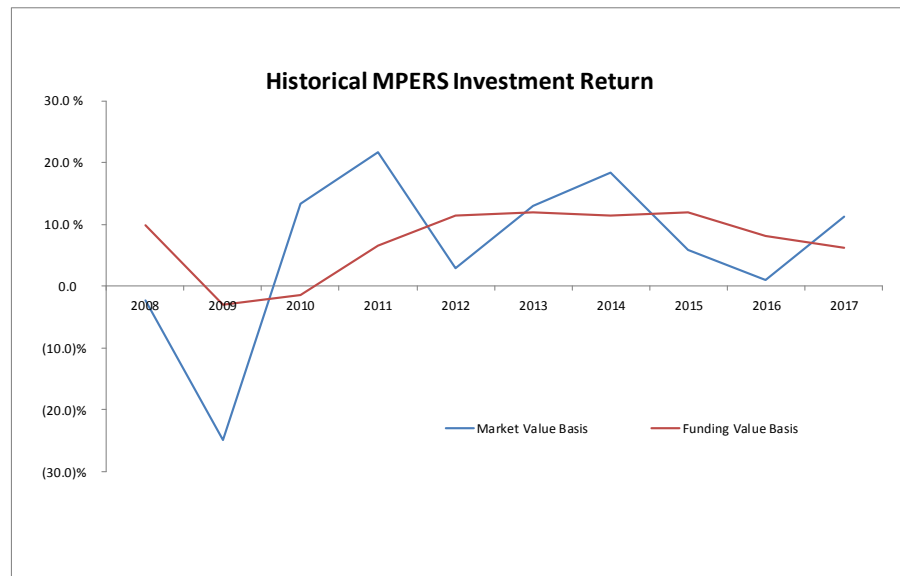
Calendar Year Period	Gross Market Returns			Stocks (S&P 500)	Price Inflation (CPI)	National Average Earnings	Sample Balanced Fund [#]	
	Bonds (Long)		Cash Equiv. (T Bills)				Total Return (I)	Spread: I - NAE - e
	U.S. Treasury	Corp. (S&P AA)						
1958-67	1.1 %	1.9 %	3.2 %	12.8 %	1.8 %	3.7 %	10.5 %	5.8 %
1968-77	5.2 %	6.1 %	5.7 %	3.6 %	6.2 %	6.5 %	4.0 %	(3.5)%
1978-87	9.5 %	9.7 %	9.2 %	15.3 %	6.4 %	6.5 %	14.2 %	6.7 %
1988-97	11.3 %	10.8 %	5.4 %	18.0 %	3.4 %	4.1 %	16.6 %	11.5 %
1998-07	7.3 %	6.7 %	3.5 %	5.9 %	2.7 %	4.0 %	6.2 %	1.2 %
2008-12	9.3 %	10.5 %	0.4 %	1.7 %	1.8 %	1.9 %	3.3 %	0.4 %
2013	(11.4)%	(7.1)%	0.0 %	32.4 %	1.5 %	1.3 %	23.9 %	21.6 %
2014	23.9 %	17.3 %	0.0 %	13.7 %	0.8 %	3.6 %	15.4 %	10.8 %
2015	(1.3)%	(4.8)%	0.5 %	1.4 %	0.7 %	3.5 %	0.7 %	(3.8)%
2016	1.2 %	10.8 %	1.1 %	12.0 %	2.1 %	2.1 %	10.3 %	7.2 %
Last 59 Years	6.7 %	7.1 %	4.6 %	10.4 %	3.7 %	4.5 %	9.7 %	4.2 %*

#Sample Balanced Fund	
Stocks	80%
Bonds - U.S. Treasury	15%
- Corporate	5%
Cash Equivalents	0%
	100%
Fund expenses(e)	1.00%

*Historical Spread	
* Observed spread is very sensitive to the observation period, even over longer periods, as illustrated below:	
Observation Period	Spread
59 years	4.2%
50 years	4.3%
40 years	5.6%
30 years	5.6%

MPERS Investment Return

Historical MPERS Investment Return		
Year	Market Value Basis	Funding Value Basis
2008	(2.4)%	9.8 %
2009	(25.0)%	(3.0)%
2010	13.3 %	(1.5)%
2011	21.7 %	6.5 %
2012	2.8 %	11.5 %
2013	13.0 %	12.0 %
2014	18.3 %	11.4 %
2015	5.9 %	12.0 %
2016	1.1 %	8.1 %
2017	11.2 %	6.2 %
5-Year Average	9.9 %	9.9 %
10-Year Average	6.0 %	7.3 %



Historical returns for the System over the last 10 years have been very volatile. As a result, the Board may wish to consider adding some conservatism to the assumption for volatility drag, if they expect this trend to continue.

We have analyzed the System's policy asset allocations as of June 30, 2017 with the capital market assumptions from eight nationally recognized investment consultants to model forward looking expectations. The investment consultants who have shared their capital market assumptions with us are (in alphabetical order) BNY Mellon, JPMorgan, Marquette, Mercer, NEPC, PCA, RVK, and VOYA. It is important to understand that in general the asset classes provided by different investment consultants will not coincide exactly. Moreover, there are differences in investment horizons, price inflation, the treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages, and other technical differences.

We have incorporated the assumptions of these eight consultants into our Capital Market Assumption Modeler (CMAM). To the best of our ability, we have adapted the System's investment policy to fit with the eight consultants' assumptions adjusting for these known differences in assumptions and methodology. In the following charts, all returns are net of investment expenses and have no assumption for excess manager performance (alpha).

Presented below is the policy asset allocation for the System as provided by MPERS:

<u>Asset Class</u>	<u>Target Weight</u>
Global Equity	30.0%
Fixed Income	20.0%
Private Equity	15.0%
Hedge Funds	10.0%
Real Estate	10.0%
Real Assets	7.5%
Opportunistic Debt	7.5%
Total	100.0%

Forward-Looking Economic Assumptions

Capital Market Assumption Modeler

The arithmetic expected return developed from the policy asset allocation is shown in the table below. The CMAM begins with the nominal expected return from each consultant (Column 2), takes out each consultant's price inflation assumption (Column 3) to arrive at the real return (Column 4). We then incorporate the high end of the recommended range for the price inflation assumption of 2.50% (Column 5) to get the expected nominal return (Column 6). Note that this return has not yet been adjusted for risk or "volatility drag." We have shown the standard deviation of returns as one measure of the investment risk (Column 7).

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)-(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Investment Expenses	Expected Nominal Return Net of Expenses (6)-(7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	5.88%	2.00%	3.88%	2.50%	6.38%	0.00%	6.38%
2	6.09%	2.20%	3.89%	2.50%	6.39%	0.00%	6.39%
3	6.57%	2.26%	4.31%	2.50%	6.81%	0.00%	6.81%
4	6.87%	2.50%	4.37%	2.50%	6.87%	0.00%	6.87%
5	6.89%	2.50%	4.39%	2.50%	6.89%	0.00%	6.89%
6	7.33%	2.25%	5.08%	2.50%	7.58%	0.00%	7.58%
7	7.55%	2.25%	5.30%	2.50%	7.80%	0.00%	7.80%
8	7.56%	2.21%	5.35%	2.50%	7.85%	0.00%	7.85%
Average	6.84%	2.27%	4.57%	2.50%	7.07%	0.00%	7.07%

We then compare the probabilities of achieving returns over a 20-year horizon. We compute the 40th, 50th, and 60th percentiles of returns as well as the probability of achieving the current assumption of 7.75% over a 20-year horizon. Alternative probabilities are shown for various assumed rates of return for comparison. Note that the investment horizon for most of the capital market assumption sets is between 5 and 10 years. For purposes of this analysis, no adjustment has been made to return expectations for 20 years.

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of Exceeding 7.75%	Probability of Exceeding 7.25%	Probability of Exceeding 7.00%
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(6)
1	5.45%	5.97%	6.50%	19.70%	26.95%	31.03%
2	5.04%	5.71%	6.39%	22.41%	28.32%	31.54%
3	5.86%	6.39%	6.93%	26.02%	34.19%	38.63%
4	5.57%	6.23%	6.89%	28.14%	34.85%	38.43%
5	5.63%	6.28%	6.93%	28.35%	35.25%	38.92%
6	6.10%	6.82%	7.54%	37.25%	43.99%	47.46%
7	7.01%	7.48%	7.95%	44.27%	54.95%	60.23%
8	6.55%	7.21%	7.88%	41.88%	49.44%	53.25%
Average	5.90%	6.51%	7.13%	31.00%	38.49%	42.44%

Forward-Looking Economic Assumptions

The 50th percentile return is also the geometric average return net of investment expenses (this is a characteristic of the lognormal distribution which is the most common distribution used to model investment returns). This is the expected return adjusted for volatility drag and is a reasonable rate of return for purposes of the valuation.

The preferred investment return assumption in the actuarial community is the forward-looking expected geometric return (i.e., 50th percentile). Based upon the average of each of the investment consultants' expectations, this would lead to an investment return assumption of 6.51% using the policy allocation. A less preferred investment return assumption, but still reasonable assumption, is the forward-looking expected arithmetic return (i.e., expected nominal return). Based on the average of each of the investment consultants' expectations, this would lead to an investment return assumption of 7.07% using the policy allocation.

To analyze the relationship between assumed investment return and price inflation in the context of the capital market assumption modeler one can examine the different scenarios outlined in the chart below:

Inflation Assumption	Average Geometric Net Nominal Return (Percentile)			Probability of Exceeding			
	40th	50th	60th	7.75%	7.25%	7.00%	6.75%
2.00%	5.40%	6.01%	6.62%	24.22%	30.97%	34.63%	38.45%
2.25%	5.65%	6.26%	6.87%	27.51%	34.65%	38.47%	42.42%
2.50%	5.90%	6.51%	7.13%	31.00%	38.49%	42.44%	46.46%
3.00%	6.40%	7.01%	7.63%	38.53%	46.50%	50.56%	54.61%

The forward looking expectations of eight investment consultants are updated in our model year over year. The CMAM results from the past three years of expectations are shown below (assuming 2.50% price inflation). Please note the participating investment consultants may vary from one year to the next.

Investment Return With Policy Allocation		
CMAM Year	Mean	Median
2015	7.09%	6.53%
2016	7.53%	6.95%
2017	7.07%	6.51%

Generally, we recommend an investment return assumption between the arithmetic mean and the geometric median of our most recent capital market assumption modeler. However, because the results of the three most recent CMAMs are not trending in a single direction, we have broadened our range slightly.

Based on forward-looking assumptions for investment returns as well as historical trends in price inflation, our recommendation is a price inflation assumption between 2.00% and 2.50% and an investment return assumption between 6.75% and 7.25%. It is important to note that the ranges are not independent of each other. For example, we would not consider a 2.00% price inflation and a 7.25% investment return assumption a reasonable set.

SECTION D

ACTIVE DECREMENT ACTIVITY – ACTUAL VS. EXPECTED

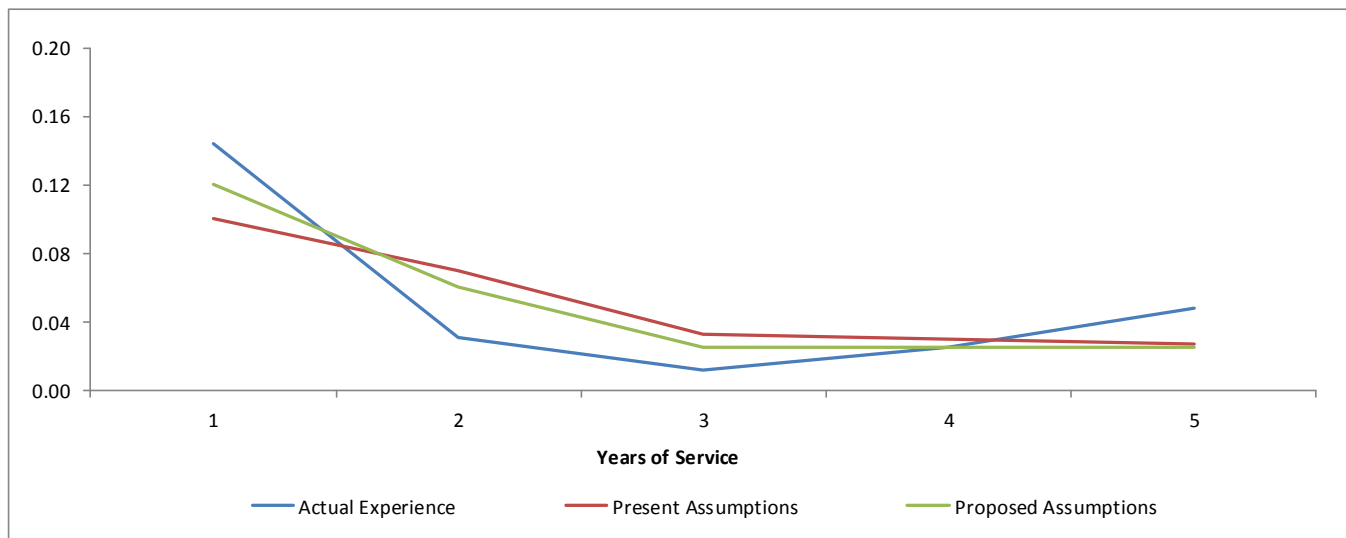
Uniformed Members

Service-Based Withdrawal Experience

Withdrawals with Less Than 5 Years of Service

There were 40 withdrawals and 1,040 years of exposure included in the service-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Years of Service	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
1	90	13	9	11	0.1444	0.1000	0.1200
2	227	7	16	14	0.0308	0.0700	0.0600
3	256	3	8	6	0.0117	0.0325	0.0250
4	238	6	7	6	0.0252	0.0300	0.0250
5	229	11	6	6	0.0480	0.0275	0.0250
Totals	1,040	40	46	43	0.0385	0.0442	0.0413



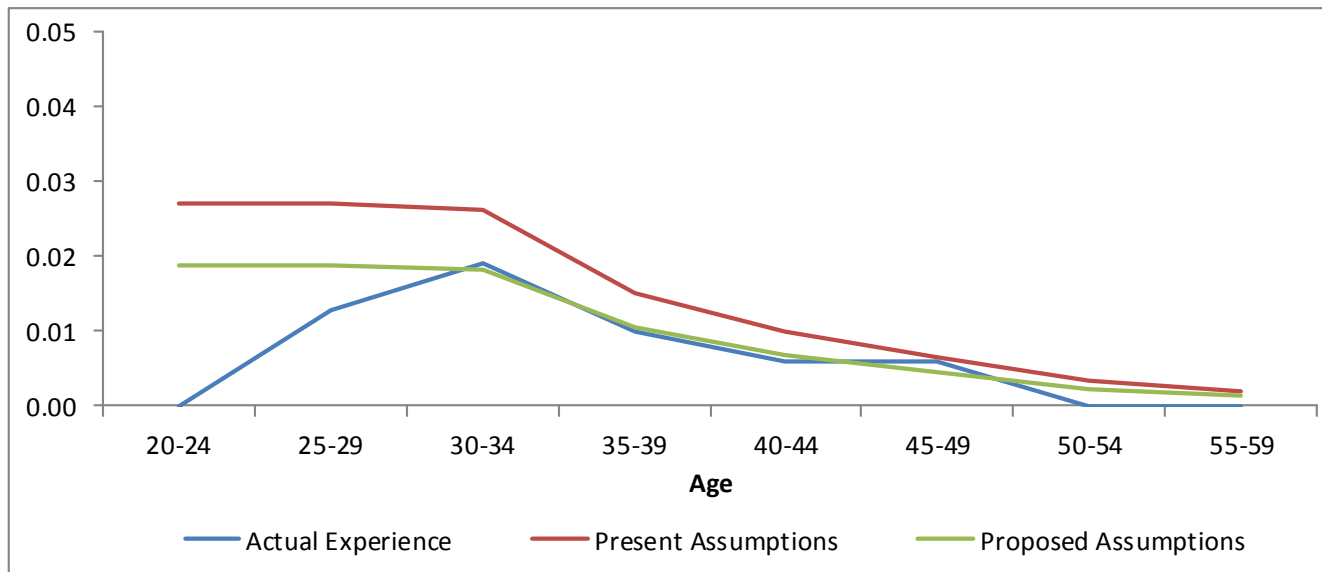
Uniformed Members

Age-Based Withdrawal Experience

Withdrawals with 5 or More Years of Service

There were 37 withdrawals and 4,542 years of exposure included in the age-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Age	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
20-24	-	-	-	-	N/A	0.0270	0.0189
25-29	234	3	6	4	0.0128	0.0270	0.0189
30-34	632	12	16	11	0.0190	0.0261	0.0183
35-39	805	8	12	9	0.0099	0.0152	0.0106
40-44	1,178	7	12	8	0.0059	0.0098	0.0069
45-49	1,165	7	8	5	0.0060	0.0065	0.0046
50-54	524	-	2	1	0.0000	0.0033	0.0023
55-59	4	-	-	-	0.0000	0.0019	0.0013
Totals	4,542	37	56	38	0.0081	0.0123	0.0084



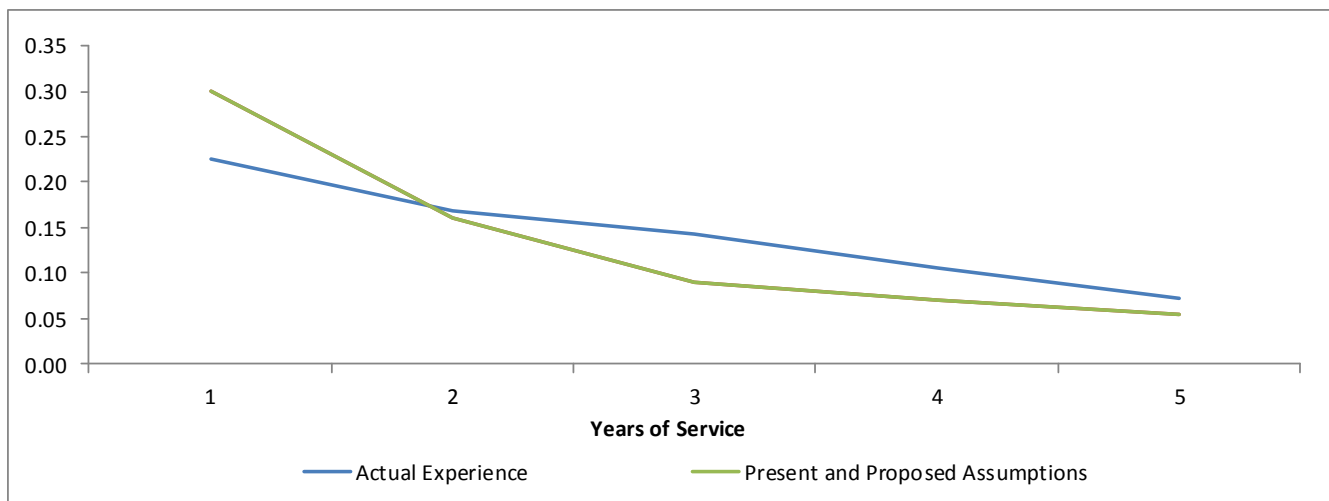
Non-Uniformed Males

Service-Based Withdrawal Experience

Withdrawals with Less Than 5 Years of Service

There were 673 withdrawals and 4,516 years of exposure included in the male service-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Years of Service	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
1	810	182	243	243	0.2247	0.3000	0.3000
2	1,393	236	223	223	0.1694	0.1600	0.1600
3	903	129	81	81	0.1429	0.0900	0.0900
4	753	79	53	53	0.1049	0.0700	0.0700
5	657	47	36	36	0.0715	0.0550	0.0550
Totals	4,516	673	636	636	0.1490	0.1408	0.1408



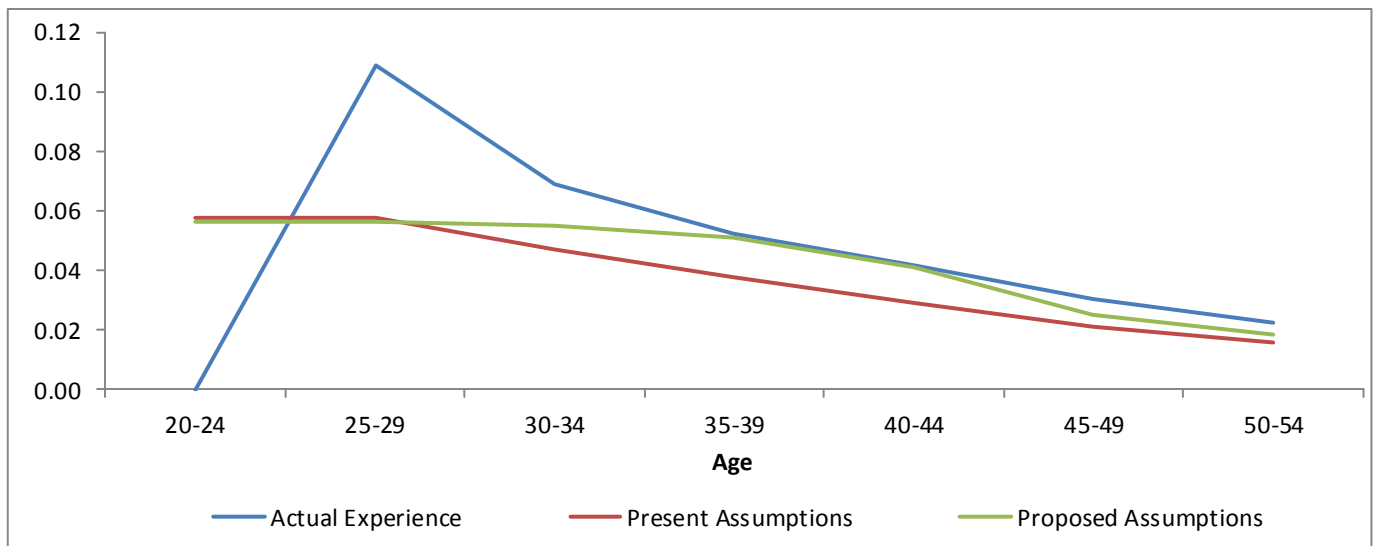
We are not recommending a change to the service based withdrawal rates due to the recent adoption of the 5-year vesting requirement for 2011 Tier members.

Non-Uniformed Males Age-Based Withdrawal Experience

Withdrawals with 5 or More Years of Service

There were 579 withdrawals and 13,809 years of exposure included in the male age-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Age	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
20-24	4	-	-	-	0.0000	0.0575	0.0560
25-29	423	46	23	24	0.1087	0.0575	0.0560
30-34	1,517	104	71	83	0.0686	0.0472	0.0546
35-39	2,177	113	81	111	0.0519	0.0375	0.0511
40-44	2,717	113	78	109	0.0416	0.0287	0.0406
45-49	3,417	103	73	86	0.0301	0.0213	0.0252
50-54	3,131	69	49	58	0.0220	0.0155	0.0182
55-59	419	28	5	6	0.0668	0.0116	0.0140
60 & Up	4	3	-	-	0.7500	0.0101	0.0140
Totals	13,809	579	380	477	0.0419	0.0275	0.0345
Totals from 30 - 54	12,959	502	352	447	0.0387	0.0272	0.0345



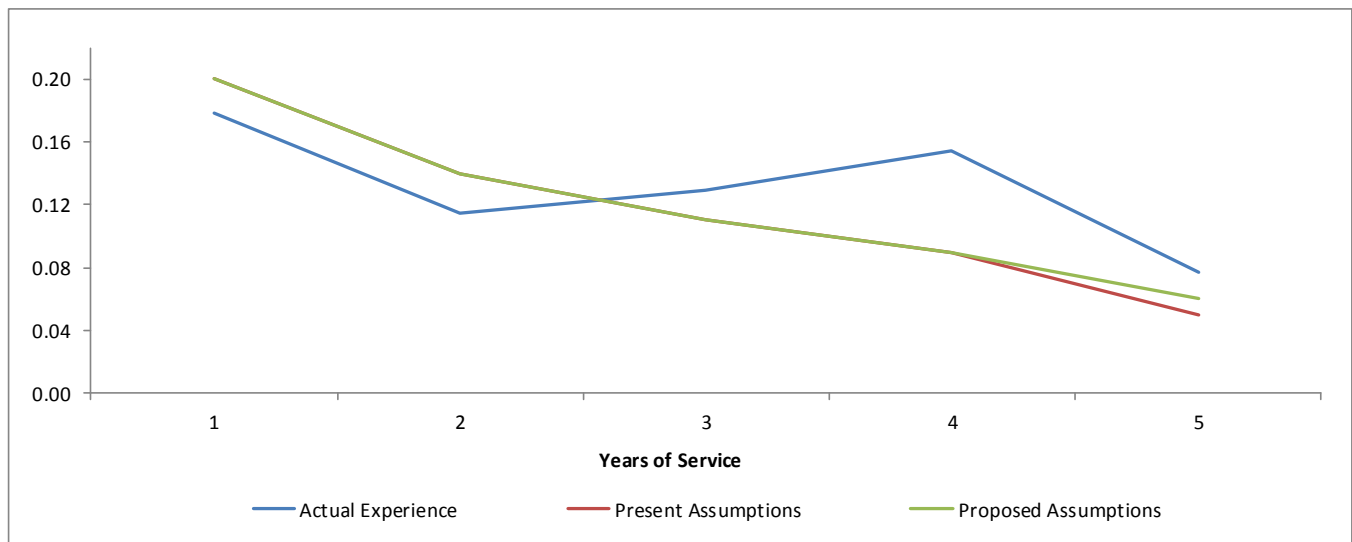
Non-Uniformed Females

Service-Based Withdrawal Experience

Withdrawals with Less Than 5 Years of Service

There were 173 withdrawals and 1,333 years of exposure included in the female service-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Years of Service	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
1	207	37	41	41	0.1787	0.2000	0.2000
2	384	44	54	54	0.1146	0.1400	0.1400
3	302	39	33	33	0.1291	0.1100	0.1100
4	246	38	22	22	0.1545	0.0900	0.0900
5	194	15	10	12	0.0773	0.0500	0.0600
Totals	1,333	173	160	162	0.1298	0.1200	0.1215



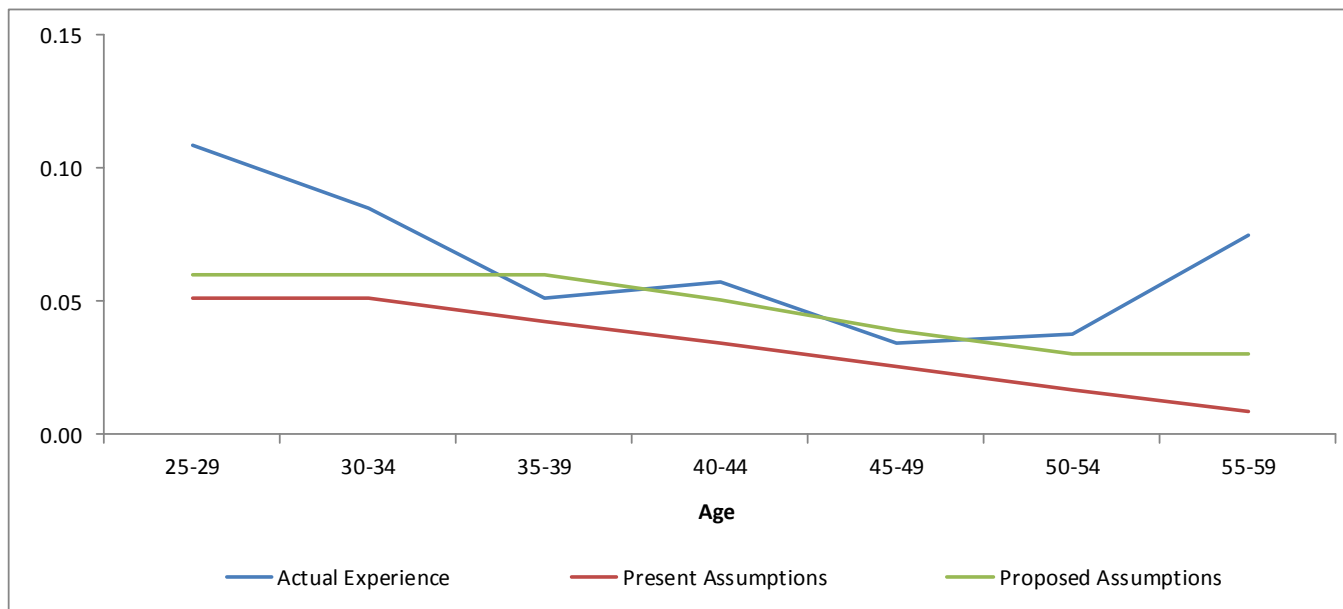
Non-Uniformed Females

Age-Based Withdrawal Experience

Withdrawals with 5 or More Years of Service

There were 248 withdrawals and 4,848 years of exposure included in the female age-based withdrawal investigation. Withdrawals are separations from active member status for a reason other than disability, death, or retirement.

Age	Life Years Exposure	Number of Withdrawals			Withdrawal Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
20-24	1	1	-	-	1.0000	0.0510	0.0600
25-29	120	13	6	7	0.1083	0.0510	0.0600
30-34	493	42	25	30	0.0852	0.0510	0.0600
35-39	757	39	32	45	0.0515	0.0425	0.0600
40-44	961	55	32	48	0.0572	0.0340	0.0505
45-49	1,343	46	34	52	0.0343	0.0255	0.0392
50-54	1,053	40	18	32	0.0380	0.0170	0.0300
55-59	120	9	1	4	0.0750	0.0085	0.0300
60 & Up	-	3	-	-	N/A	0.0000	0.0300
Totals	4,848	248	148	218	0.0512	0.0305	0.0450

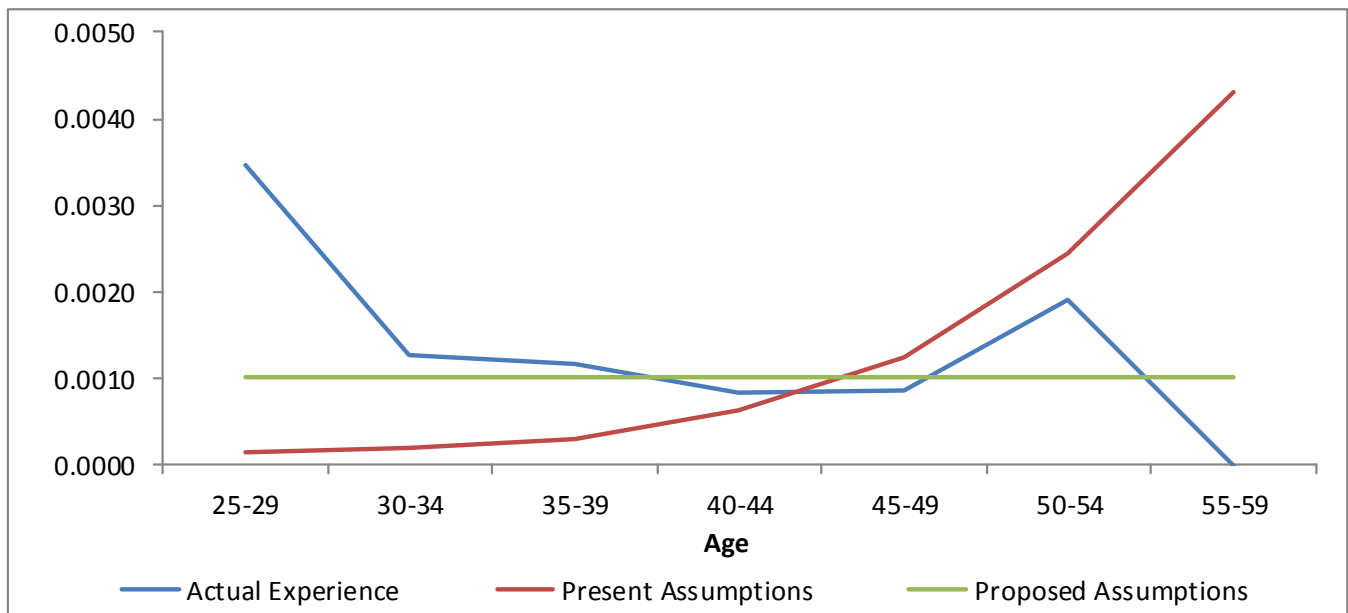


Uniformed Members Disability Experience

Disabled Uniformed Members

There were 8 disability benefit claims reported for the 5-year period and 5,434 years of exposure.

Age	Life Years Exposure	Number of Disabilities			Disability Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
25-29	863	3	-	1	0.0035	0.0002	0.0010
30-34	793	1	-	1	0.0013	0.0002	0.0010
35-39	868	1	-	1	0.0012	0.0003	0.0010
40-44	1,203	1	1	1	0.0008	0.0006	0.0010
45-49	1,178	1	1	1	0.0008	0.0012	0.0010
50-54	525	1	1	1	0.0019	0.0024	0.0010
55-59	4	-	-	-	0.0000	0.0043	0.0010
Totals	5,434	8	3	6	0.0015	0.0006	0.0010

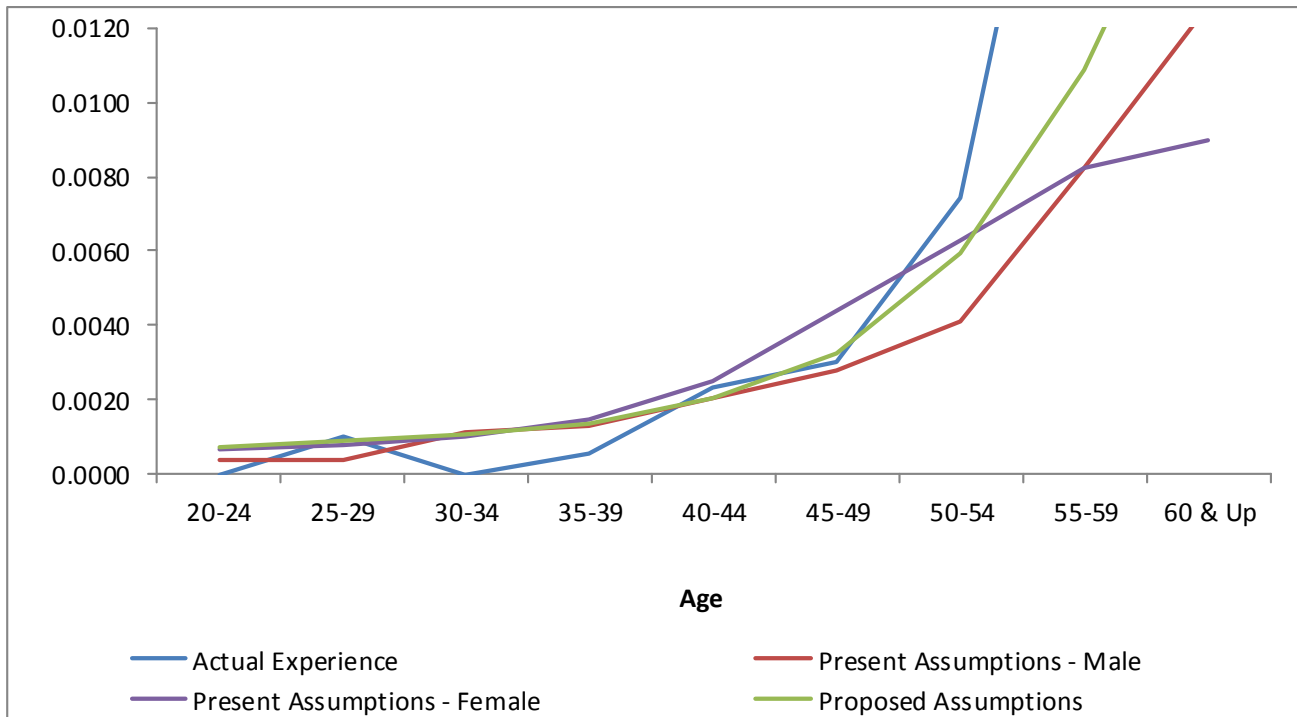


Non-Uniformed Members Disability Experience

Disabled Non-Uniformed Members

There were 89 disability benefit claims reported for the 5-year period and 24,404 years of exposure.

Age	Life Years Exposure	Number of Disabilities			Disability Rates			
		Actual Experience	Expected		Actual	Expected		
			Present	Proposed		Present Male	Present Female	Proposed
20-24	435	-	-	-	0.0000	0.0004	0.0006	0.0007
25-29	2,009	2	1	2	0.0010	0.0004	0.0008	0.0009
30-34	2,939	-	3	3	0.0000	0.0011	0.0010	0.0011
35-39	3,661	2	5	5	0.0005	0.0013	0.0015	0.0014
40-44	4,300	10	9	9	0.0023	0.0020	0.0025	0.0021
45-49	5,321	16	17	18	0.0030	0.0028	0.0044	0.0032
50-54	4,704	35	22	28	0.0074	0.0041	0.0063	0.0059
55-59	908	21	7	9	0.0231	0.0082	0.0082	0.0109
60 & Up	127	3	1	2	0.0236	0.0126	0.0090	0.0180
Totals	24,404	89	65	76	0.0036	0.0025	0.0031	0.0031

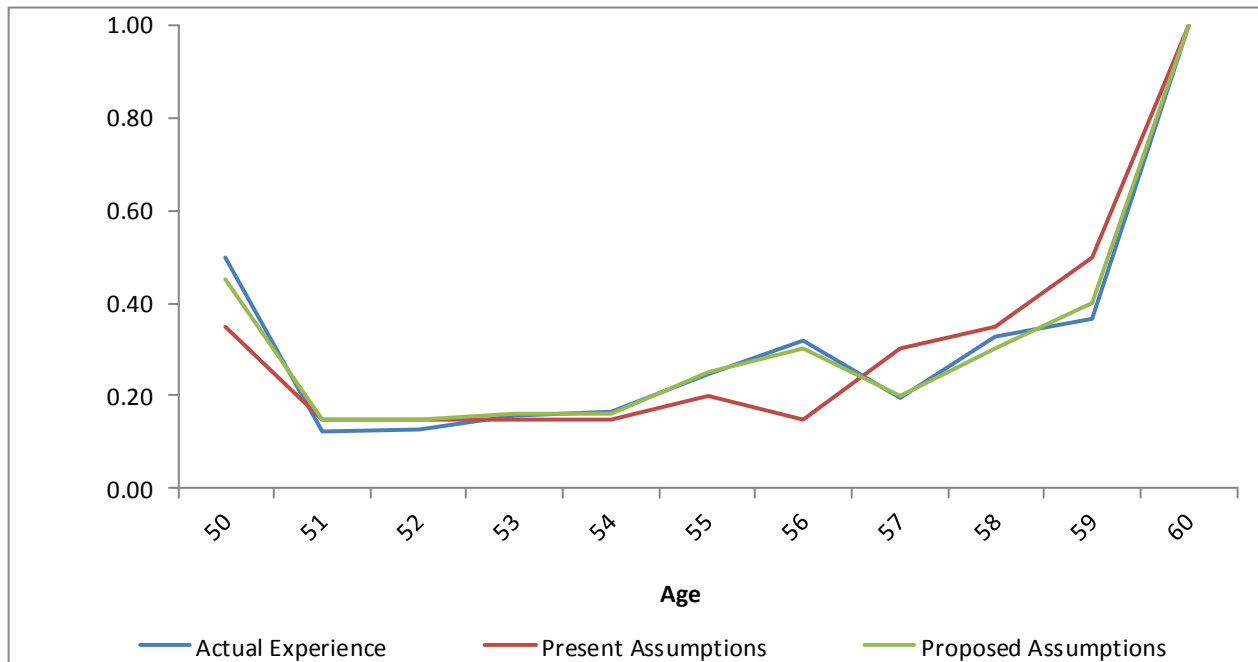


Uniformed Members Closed and Year 2000 Plans Normal Retirement Experience

Uniformed Age & Service Unreduced Retirement Experience

There were 144 age and service unreduced retirements and 587 life years of exposure (exposure includes active members eligible for unreduced retirement) in the retirement investigation.

Age	Life Years Exposure	Number of Retirements			Retirement Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
50	2	1	1	1	0.5000	0.3500	0.4500
51	24	3	4	4	0.1250	0.1500	0.1500
52	63	8	9	9	0.1270	0.1500	0.1500
53	89	14	13	14	0.1573	0.1500	0.1600
54	96	16	14	15	0.1667	0.1500	0.1600
55	97	24	19	24	0.2474	0.2000	0.2500
56	72	23	11	22	0.3194	0.1500	0.3000
57	51	10	15	10	0.1961	0.3000	0.2000
58	43	14	15	13	0.3256	0.3500	0.3000
59	30	11	15	12	0.3667	0.5000	0.4000
60	20	20	20	20	1.0000	1.0000	1.0000
Totals	587	144	136	144	0.2453	0.2317	0.2453



Uniformed Members 2011 Tier Plan Normal Retirement Experience

Uniformed Age & Service Unreduced Retirement Assumption

The data for 2011 Tier plan members is insufficient for retirement rate analysis purposes. The present rates appear generally reasonable and we recommend their continued use.

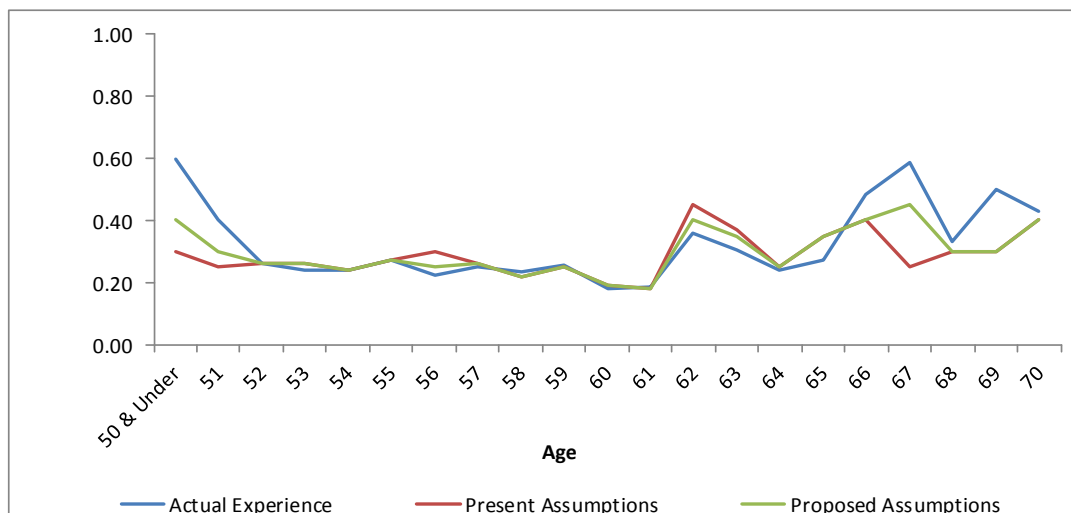
Age	Retirement Rates	
	Present	Proposed
55	0.3000	0.3000
56	0.3000	0.3000
57	0.3000	0.3000
58	0.3000	0.3000
59	0.3000	0.3000
60	1.0000	1.0000

Non-Uniformed Males Closed and Year 2000 Plans Normal Retirement Experience

Non-Uniformed Males Age & Service Unreduced Retirement Experience

There were 827 age and service unreduced retirements and 2,993 life years of exposure (exposure includes active members eligible for unreduced retirement) in the male retirement investigation.

Age	Life Years Exposure	Number of Retirements			Retirement Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
50 & Under	62	37	19	25	0.5968	0.3000	0.4000
51	120	48	30	36	0.4000	0.2500	0.3000
52	189	49	49	49	0.2593	0.2600	0.2600
53	236	57	61	61	0.2415	0.2600	0.2600
54	241	57	58	58	0.2365	0.2400	0.2400
55	253	69	68	68	0.2727	0.2700	0.2700
56	207	46	62	52	0.2222	0.3000	0.2500
57	190	48	49	49	0.2526	0.2600	0.2600
58	171	40	38	38	0.2339	0.2200	0.2200
59	155	40	39	39	0.2581	0.2500	0.2500
60	220	40	42	42	0.1818	0.1900	0.1900
61	189	35	34	34	0.1852	0.1800	0.1800
62	263	94	118	105	0.3574	0.4500	0.4000
63	151	46	56	53	0.3046	0.3700	0.3500
64	105	25	26	26	0.2381	0.2500	0.2500
65	81	22	28	28	0.2716	0.3500	0.3500
66	64	31	26	26	0.4844	0.4000	0.4000
67	34	20	9	15	0.5882	0.2500	0.4500
68	18	6	5	5	0.3333	0.3000	0.3000
69	12	6	4	4	0.5000	0.3000	0.3000
70	7	3	3	3	0.4286	0.4000	0.4000
71	5	2	3	3	0.4000	0.5000	0.5000
72	4	2	2	2	0.5000	0.5000	0.5000
73	1	-	1	1	0.0000	0.5000	0.5000
74	2	-	2	2	0.0000	1.0000	1.0000
75 & Over	13	4	13	13	0.3077	1.0000	1.0000
Totals	2,993	827	845	837	0.2763	0.2823	0.2797

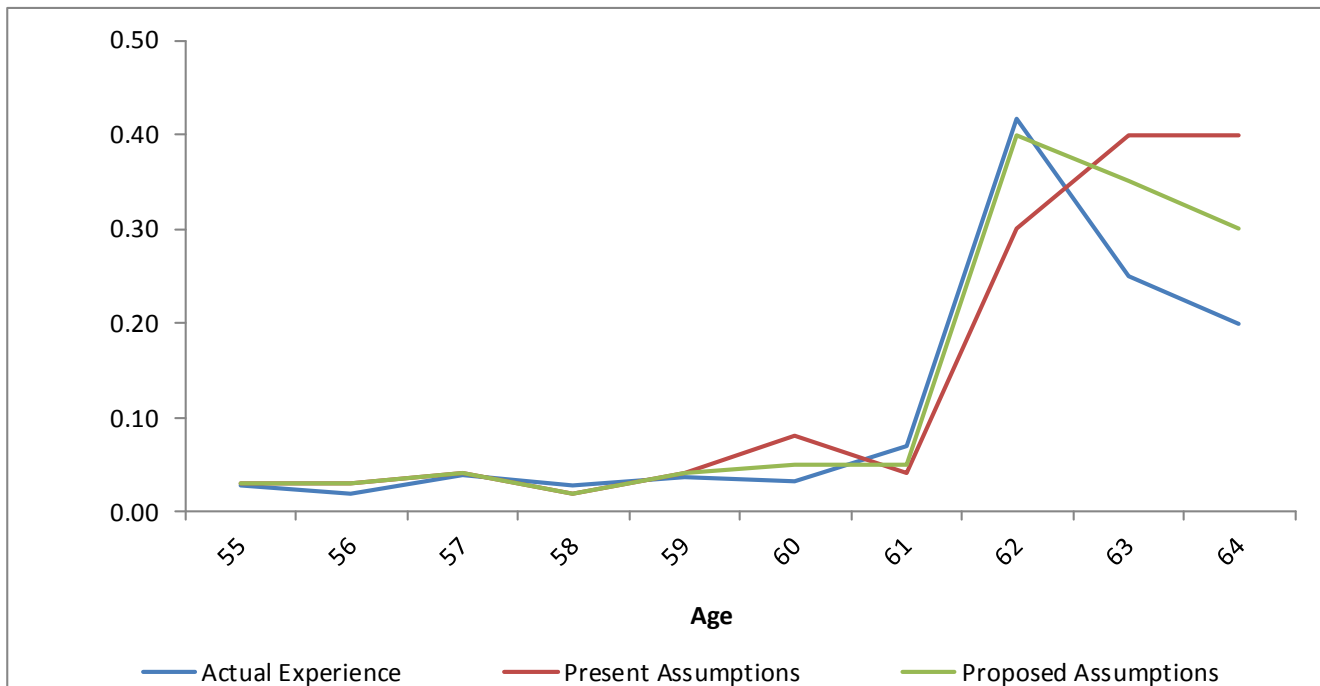


Non-Uniformed Males Closed and Year 2000 Plans Early Retirement Experience

Non-Uniformed Males Age & Service Reduced Retirement Experience

There were 62 age and service reduced retirements and 1,624 life years of exposure (exposure includes active members eligible for reduced retirement) in the male retirement investigation.

Age	Life Years Exposure	Number of Retirements			Retirement Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
55	223	6	7	7	0.0269	0.0300	0.0300
56	206	4	6	6	0.0194	0.0300	0.0300
57	344	13	14	14	0.0378	0.0400	0.0400
58	297	8	6	6	0.0269	0.0200	0.0200
59	247	9	10	10	0.0364	0.0400	0.0400
60	151	5	12	8	0.0331	0.0800	0.0500
61	131	9	5	7	0.0687	0.0400	0.0500
62	12	5	4	5	0.4167	0.3000	0.4000
63	8	2	3	3	0.2500	0.4000	0.3500
64	5	1	2	2	0.2000	0.4000	0.3000
Totals	1,624	62	69	68	0.0382	0.0425	0.0419

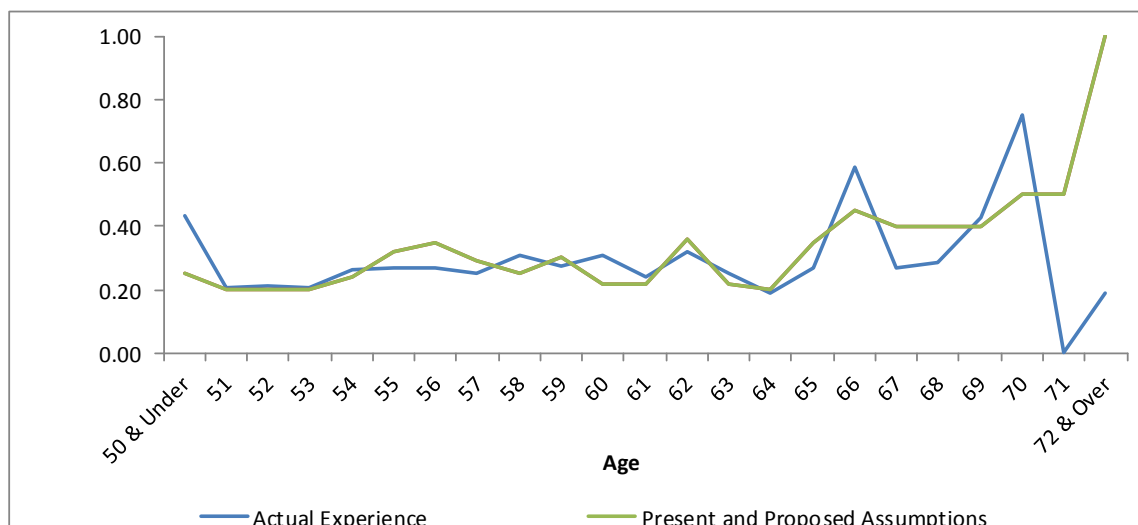


Non-Uniformed Females Closed and Year 2000 Plans Normal Retirement Experience

Non-Uniformed Females Age & Service Unreduced Retirement Experience

There were 297 age and service unreduced retirements and 1,080 life years of exposure (exposure includes active members eligible for unreduced retirement) in the female retirement investigation.

Age	Life Years Exposure	Number of Retirements			Retirement Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
50 & Under	30	13	8	8	0.4333	0.2500	0.2500
51	44	9	9	9	0.2045	0.2000	0.2000
52	76	16	15	15	0.2105	0.2000	0.2000
53	78	16	16	16	0.2051	0.2000	0.2000
54	80	21	19	19	0.2625	0.2400	0.2400
55	79	21	25	25	0.2658	0.3200	0.3200
56	71	19	25	25	0.2676	0.3500	0.3500
57	67	17	19	19	0.2537	0.2900	0.2900
58	62	19	16	16	0.3065	0.2500	0.2500
59	58	16	17	17	0.2759	0.3000	0.3000
60	74	23	16	16	0.3108	0.2200	0.2200
61	54	13	12	12	0.2407	0.2200	0.2200
62	78	25	28	28	0.3205	0.3600	0.3600
63	59	15	13	13	0.2542	0.2200	0.2200
64	47	9	9	9	0.1915	0.2000	0.2000
65	37	10	13	13	0.2703	0.3500	0.3500
66	34	20	15	15	0.5882	0.4500	0.4500
67	15	4	6	6	0.2667	0.4000	0.4000
68	7	2	3	3	0.2857	0.4000	0.4000
69	7	3	3	3	0.4286	0.4000	0.4000
70	4	3	2	2	0.7500	0.5000	0.5000
71	3	-	2	2	0.0000	0.5000	0.5000
72 & Over	16	3	16	16	0.1875	1.0000	1.0000
Totals	1,080	297	307	307	0.2750	0.2843	0.2843

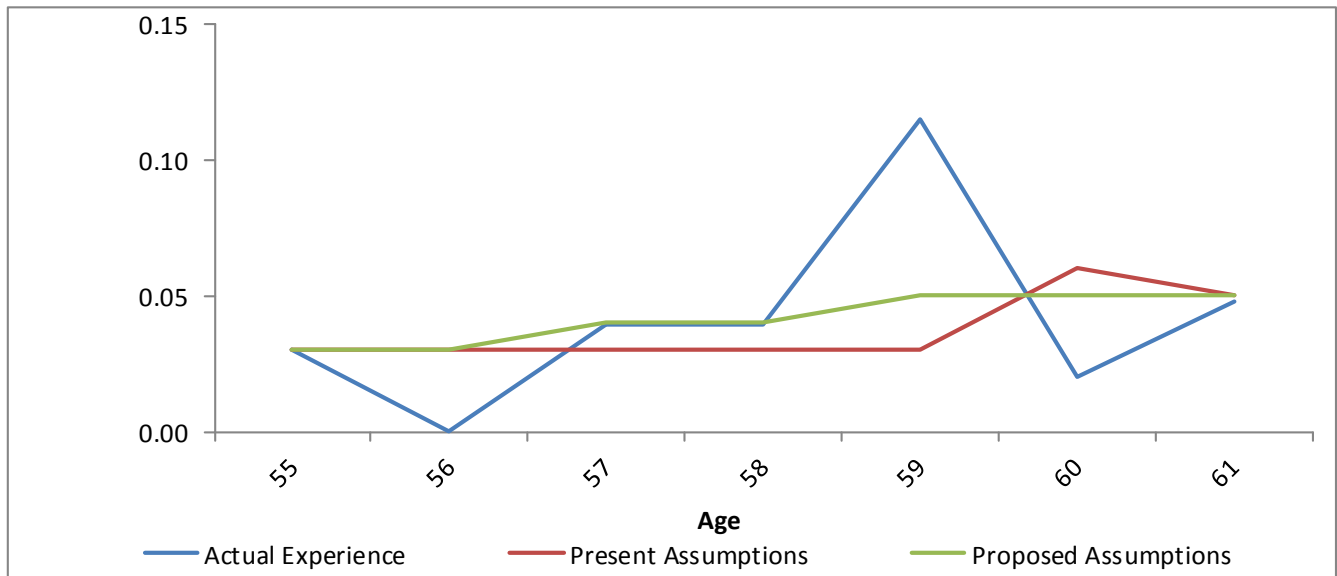


Non-Uniformed Females Closed and Year 2000 Plans Early Retirement Experience

Non-Uniformed Females Age & Service Reduced Retirement Experience

There were 25 age and service reduced retirements and 591 life years of exposure (exposure includes active members eligible for reduced retirement) in the female retirement investigation.

Age	Life Years Exposure	Number of Retirements			Retirement Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
55	99	3	3	3	0.0303	0.0300	0.0300
56	85	-	3	3	0.0000	0.0300	0.0300
57	126	5	4	5	0.0397	0.0300	0.0400
58	102	4	3	4	0.0392	0.0300	0.0400
59	87	10	3	4	0.1149	0.0300	0.0500
60	50	1	3	3	0.0200	0.0600	0.0500
61	42	2	2	2	0.0476	0.0500	0.0500
Totals	591	25	21	24	0.0423	0.0355	0.0406



Non-Uniformed Members 2011 Tier Plan Normal Retirement Experience

Non-Uniformed Age & Service Unreduced Retirement Assumption

The data for 2011 Tier plan members is insufficient for retirement purposes. The present rates appear generally reasonable and we recommend their continued use.

Age	Present		Proposed	
	Age & Service	Rule of 90	Age & Service	Rule of 90
55		0.3000		0.3000
56		0.3000		0.3000
57		0.3000		0.3000
58		0.3000		0.3000
59		0.3000		0.3000
60		0.3000		0.3000
61		0.3000		0.3000
62		0.3000		0.3000
63		0.3000		0.3000
64		0.3000		0.3000
65		0.3000		0.3000
66		0.3000		0.3000
67	0.5000	0.3000	0.5000	0.3000
68	0.5000	0.3000	0.5000	0.3000
69	0.5000	0.3000	0.5000	0.3000
70	1.0000	1.0000	1.0000	1.0000
71	1.0000	1.0000	1.0000	1.0000
72	1.0000	1.0000	1.0000	1.0000

Non-Uniformed Members 2011 Tier Plan Early Retirement Experience

Non-Uniformed Age & Service Reduced Retirement Assumption

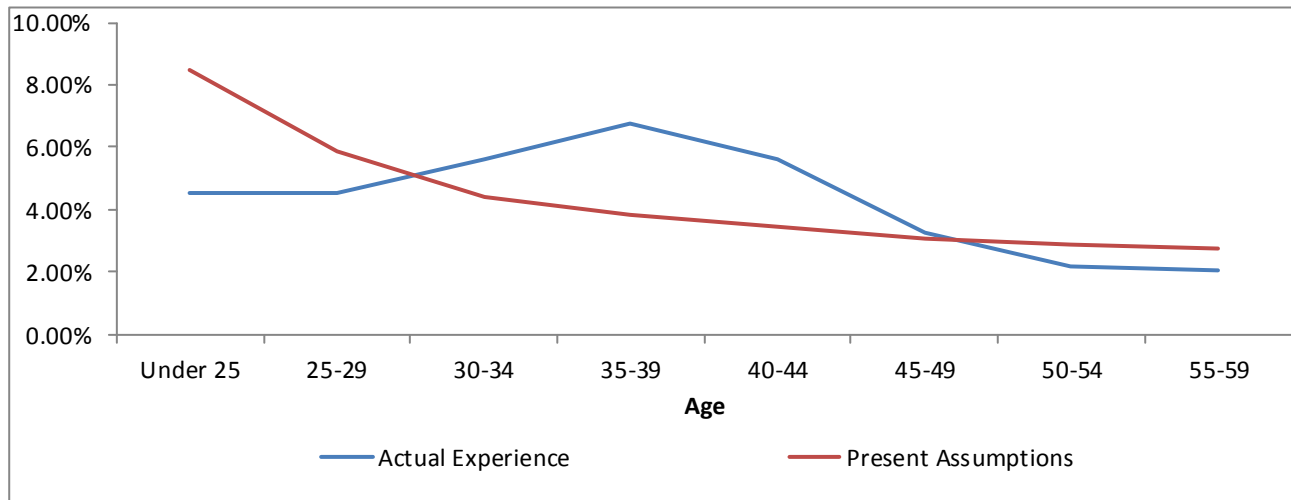
The data for 2011 Tier plan members is insufficient for early retirement purposes. The present rates appear generally reasonable and we recommend their continued use.

Age	Retirement Rates	
	Present	Proposed
62	0.1000	0.1000
63	0.1000	0.1000
64	0.1000	0.1000
65	0.1000	0.1000
66	0.1000	0.1000

Uniformed Members Pay Increase Assumptions

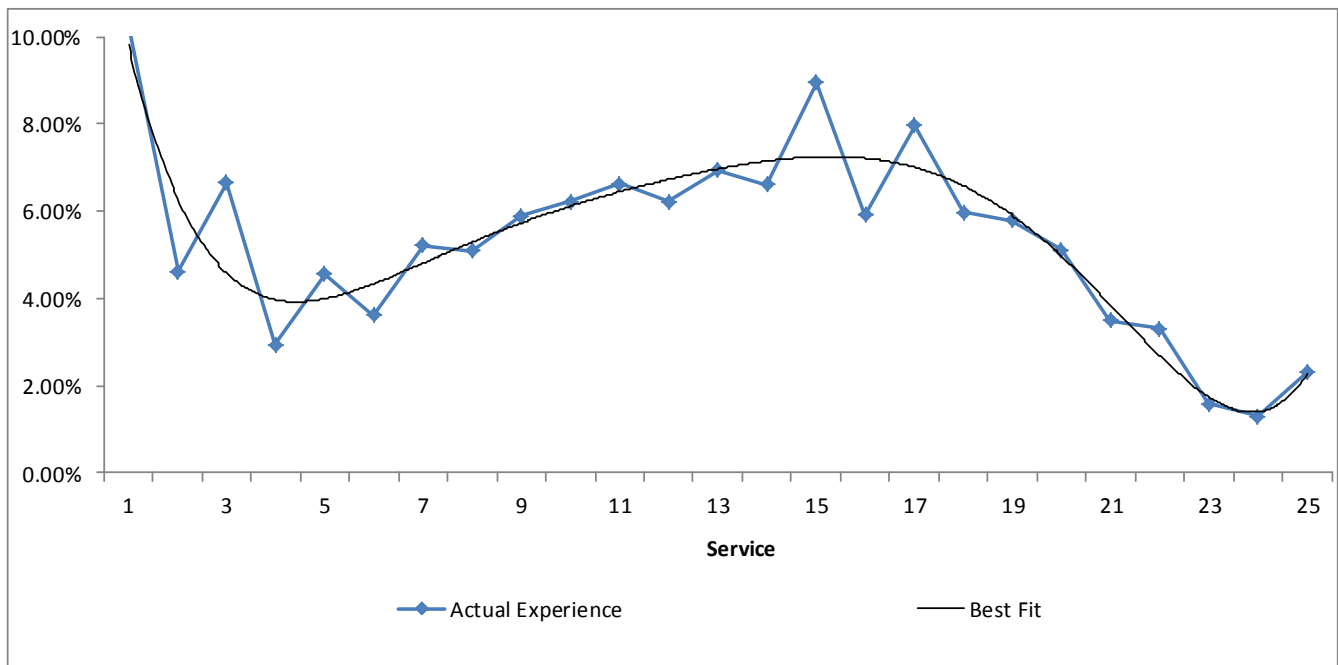
The graphs shown below illustrate gross rates of salary increases for Uniformed Members, according to age and service respectively.

Gross Salary Increases – Correlation by Age*



**Only includes members with more than 3 years of service.*

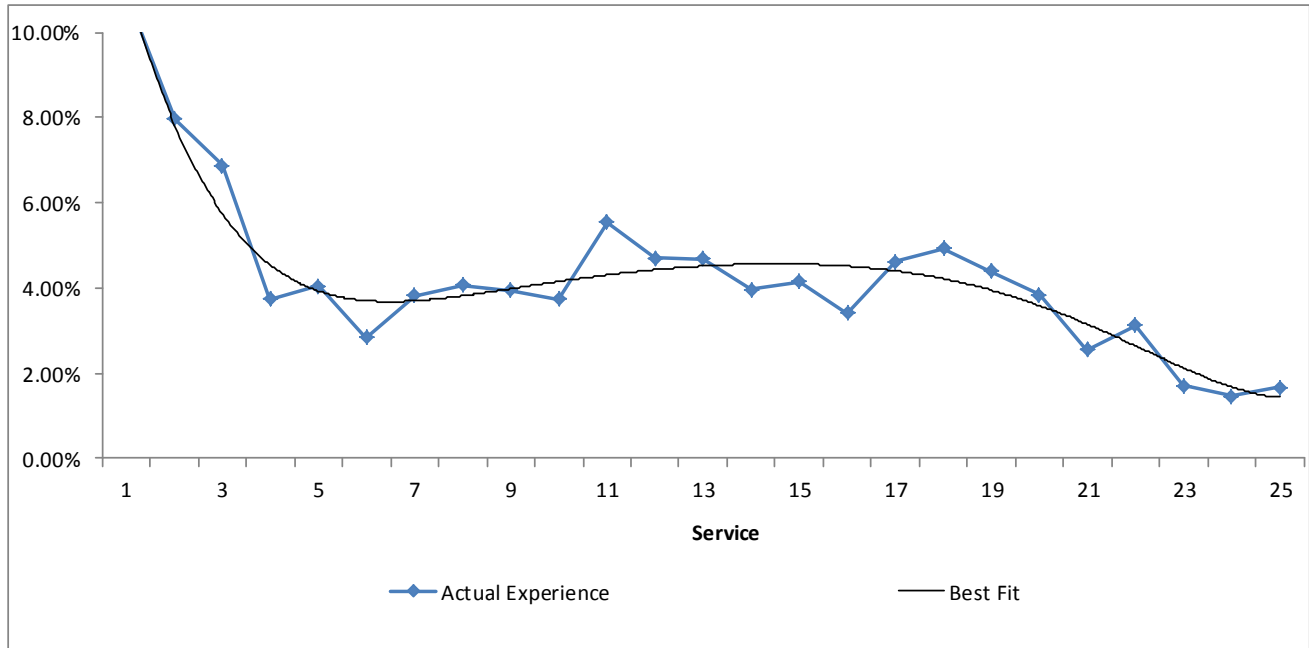
Gross Salary Increases – Correlation by Service



Uniformed Members Pay Increase Assumptions

The graphs on the previous page show gross rates of salary increases from 2012 to 2017. Since the gross rates of salary increases from 2012 to 2017 did not show a strong correlation between either age or service, we extended our study from 2007 to 2012. These results are shown below:

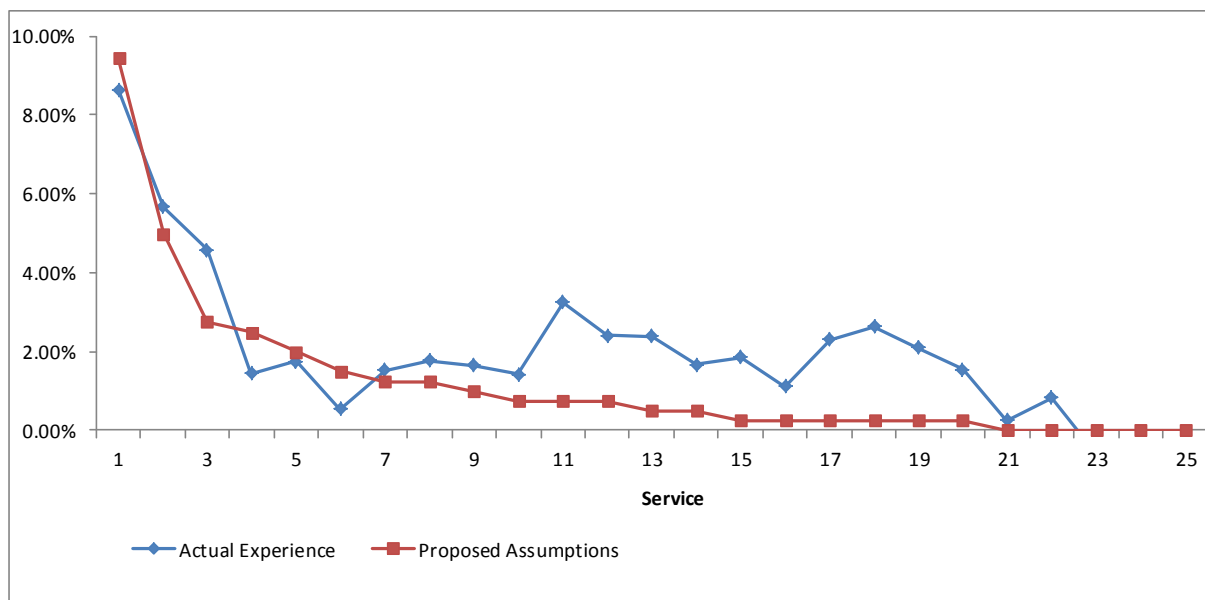
Gross Salary Increases – Correlation by Service 2007 to 2012



The study from 2007 to 2012 shows a strong correlation between merit and longevity salary increases and service. Therefore, we are recommending service bases rates which are shown on the next page along with actual experience from 2007 to 2012.

Uniformed Members Pay Increase Assumptions

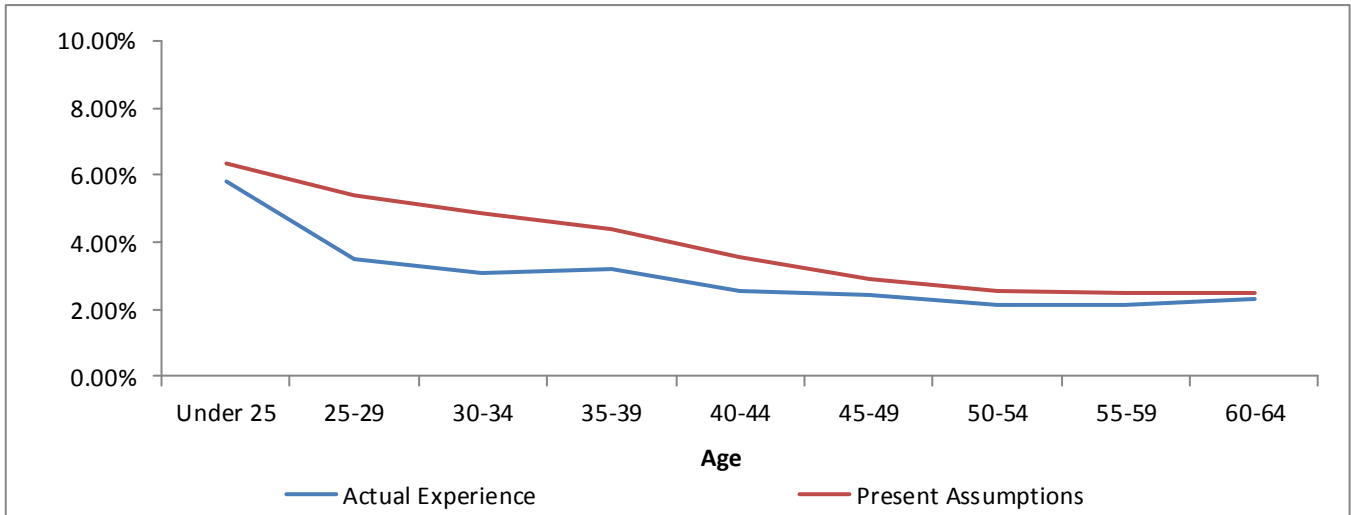
Service Index	Number	Merit & Seniority		Total % Increase (Including Wage Inflation)	
		Actual	Proposed	Actual	Proposed
1	160	8.64 %	9.45 %	10.94 %	12.45 %
2	428	5.67 %	5.00 %	7.97 %	8.00 %
3	432	4.59 %	2.75 %	6.89 %	5.75 %
4	399	1.44 %	2.50 %	3.74 %	5.50 %
5	386	1.75 %	2.00 %	4.05 %	5.00 %
6	398	0.55 %	1.50 %	2.85 %	4.50 %
7	374	1.53 %	1.25 %	3.83 %	4.25 %
8	380	1.77 %	1.25 %	4.07 %	4.25 %
9	373	1.65 %	1.00 %	3.95 %	4.00 %
10	365	1.43 %	0.75 %	3.73 %	3.75 %
11	384	3.25 %	0.75 %	5.55 %	3.75 %
12	409	2.41 %	0.75 %	4.71 %	3.75 %
13	453	2.39 %	0.50 %	4.69 %	3.50 %
14	476	1.68 %	0.50 %	3.98 %	3.50 %
15	489	1.85 %	0.25 %	4.15 %	3.25 %
16	477	1.12 %	0.25 %	3.42 %	3.25 %
17	447	2.32 %	0.25 %	4.62 %	3.25 %
18	465	2.63 %	0.25 %	4.93 %	3.25 %
19	483	2.11 %	0.25 %	4.41 %	3.25 %
20	461	1.55 %	0.25 %	3.85 %	3.25 %
21	428	0.25 %	0.00 %	2.55 %	3.00 %
22	388	0.83 %	0.00 %	3.13 %	3.00 %
23	336	(0.58)%	0.00 %	1.72 %	3.00 %
24	298	(0.84)%	0.00 %	1.46 %	3.00 %
25	259	(0.63)%	0.00 %	1.67 %	3.00 %



Non-Uniformed Members Pay Increase Assumptions

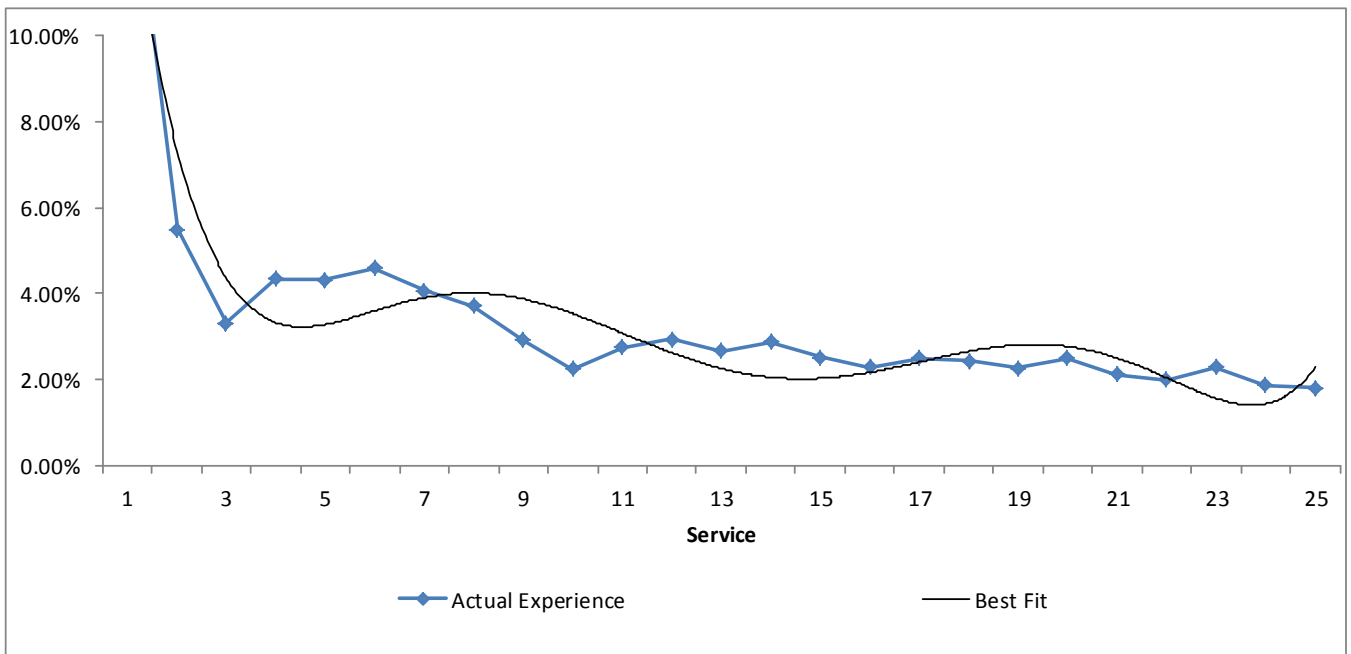
The graphs shown below illustrate rates of gross salary increases for Non-Uniformed Members, according to age and service respectively. They demonstrate that rates of salary increases are highly correlated with service. New rates (merit and longevity portion only) are shown on the following page.

Gross Salary Increases – Correlation by Age*



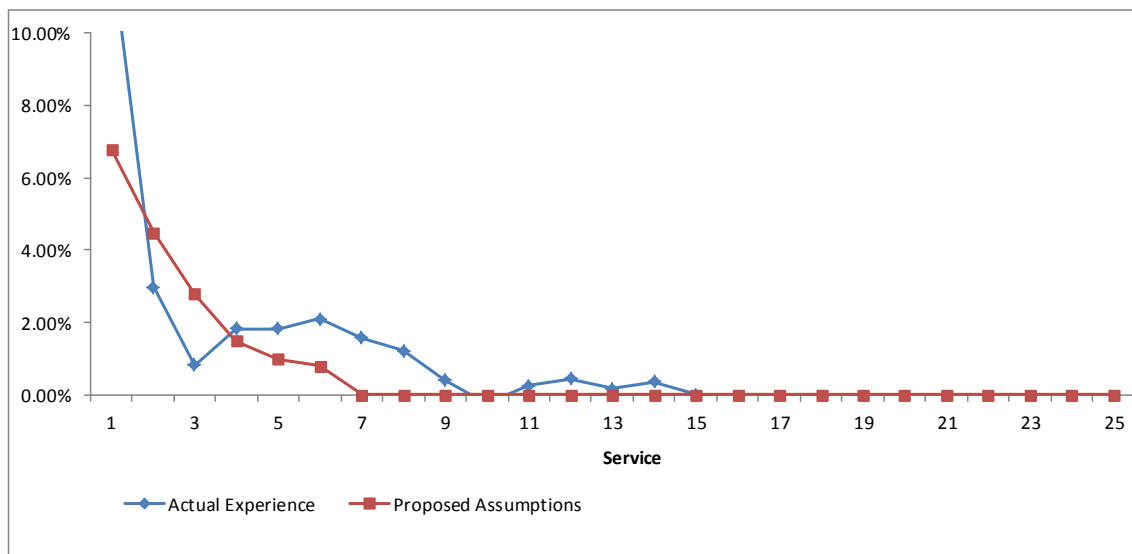
*Only includes members with more than 5 years of service.

Gross Salary Increases – Correlation by Service



Non-Uniformed Members Pay Increase Assumptions

Service Index	Number	Merit & Seniority		Total % Increase (Including Wage Inflation)	
		Actual	Proposed	Actual	Proposed
1	796	12.43 %	6.80 %	14.93 %	9.80 %
2	1,496	2.99 %	4.50 %	5.49 %	7.50 %
3	1,037	0.82 %	2.80 %	3.32 %	5.80 %
4	881	1.84 %	1.50 %	4.34 %	4.50 %
5	819	1.83 %	1.00 %	4.33 %	4.00 %
6	903	2.10 %	0.80 %	4.60 %	3.80 %
7	1,036	1.57 %	0.00 %	4.07 %	3.00 %
8	1,103	1.22 %	0.00 %	3.72 %	3.00 %
9	1,169	0.41 %	0.00 %	2.91 %	3.00 %
10	1,168	(0.25)%	0.00 %	2.25 %	3.00 %
11	1,110	0.25 %	0.00 %	2.75 %	3.00 %
12	1,078	0.45 %	0.00 %	2.95 %	3.00 %
13	1,151	0.16 %	0.00 %	2.66 %	3.00 %
14	1,157	0.37 %	0.00 %	2.87 %	3.00 %
15	1,103	0.01 %	0.00 %	2.51 %	3.00 %
16	1,072	(0.21)%	0.00 %	2.29 %	3.00 %
17	1,048	(0.00)%	0.00 %	2.50 %	3.00 %
18	972	(0.07)%	0.00 %	2.43 %	3.00 %
19	939	(0.23)%	0.00 %	2.27 %	3.00 %
20	923	(0.01)%	0.00 %	2.49 %	3.00 %
21	898	(0.38)%	0.00 %	2.12 %	3.00 %
22	822	(0.51)%	0.00 %	1.99 %	3.00 %
23	758	(0.21)%	0.00 %	2.29 %	3.00 %
24	659	(0.63)%	0.00 %	1.88 %	3.00 %
25	594	(0.69)%	0.00 %	1.81 %	3.00 %

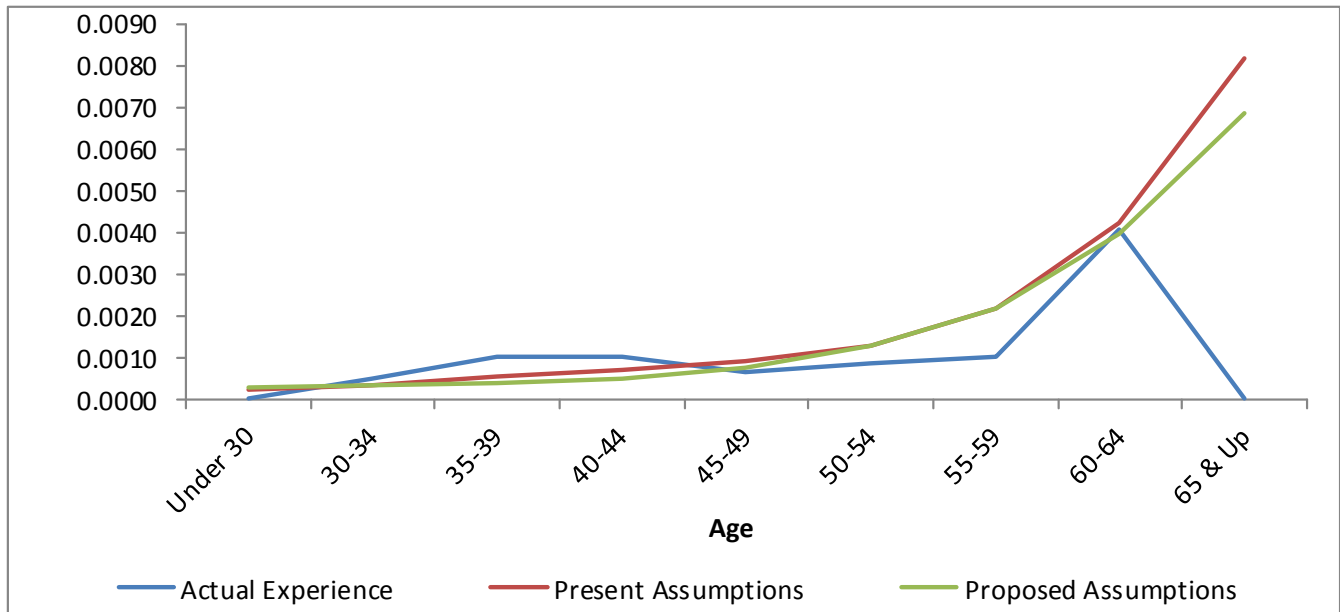


Male Death-in-Service Experience

Male Deaths

There were 23 active male deaths reported for the 5-year period and 23,560 life years of exposure included in the male active mortality investigation. 0 of these deaths have been duty related. As such, we will continue to assume 100% of Death-in-Service is non-duty related.

Age	Life Years Exposure	Pre-Retirement Death			Pre-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
Under 30	734	-	-	-	0.0000	0.00024	0.00030
30-34	2,129	1	1	1	0.0005	0.00032	0.00035
35-39	2,989	3	1	1	0.0010	0.00054	0.00041
40-44	3,891	4	2	2	0.0010	0.00069	0.00051
45-49	4,577	3	4	4	0.0007	0.00090	0.00078
50-54	4,782	4	6	6	0.0008	0.00126	0.00131
55-59	3,013	3	6	6	0.0010	0.00220	0.00219
60-64	1,236	5	5	5	0.0040	0.00422	0.00397
65 & Up	209	-	1	1	0.0000	0.00818	0.00684
Totals	23,560	23	26	26	0.0010	0.00110	0.00110

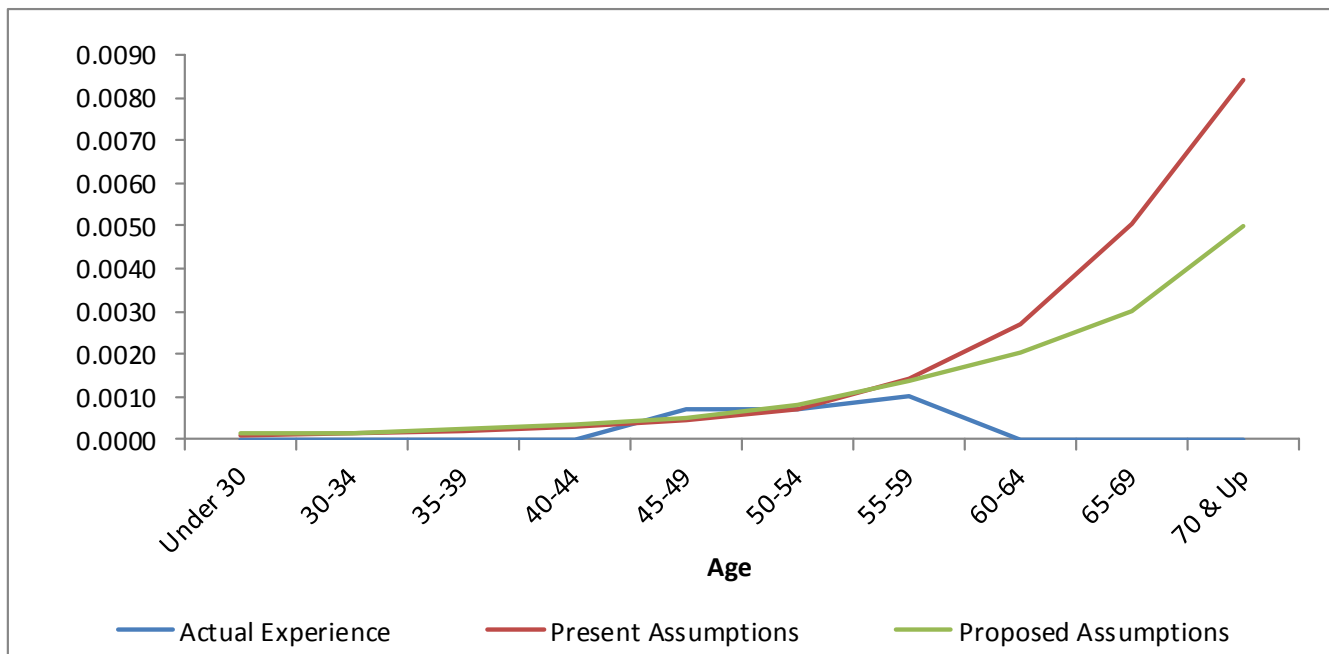


Female Death-in-Service Experience

Female Deaths

There were 3 active female deaths reported for the 5-year period and 6,791 life years of exposure included in the female active mortality investigation. Only one of these deaths has been duty related. As such, we will continue to assume that 100% of Death-in-Service is non-duty related.

Age	Life Years Exposure	Pre-Retirement Death			Pre-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
Under 30	162	-	-	-	0.0000	0.00009	0.00013
30-34	550	-	-	-	0.0000	0.00014	0.00017
35-39	803	-	-	-	0.0000	0.00021	0.00024
40-44	1,016	-	-	-	0.0000	0.00030	0.00034
45-49	1,391	1	1	1	0.0007	0.00047	0.00052
50-54	1,393	1	1	1	0.0007	0.00072	0.00084
55-59	963	1	1	1	0.0010	0.00140	0.00135
60-64	406	-	1	1	0.0000	0.00268	0.00201
65-69	100	-	-	-	0.0000	0.00506	0.00303
70 & Up	7	-	-	-	0.0000	0.00844	0.00501
Totals	6,791	3	4	4	0.0004	0.00059	0.00059



SECTION E

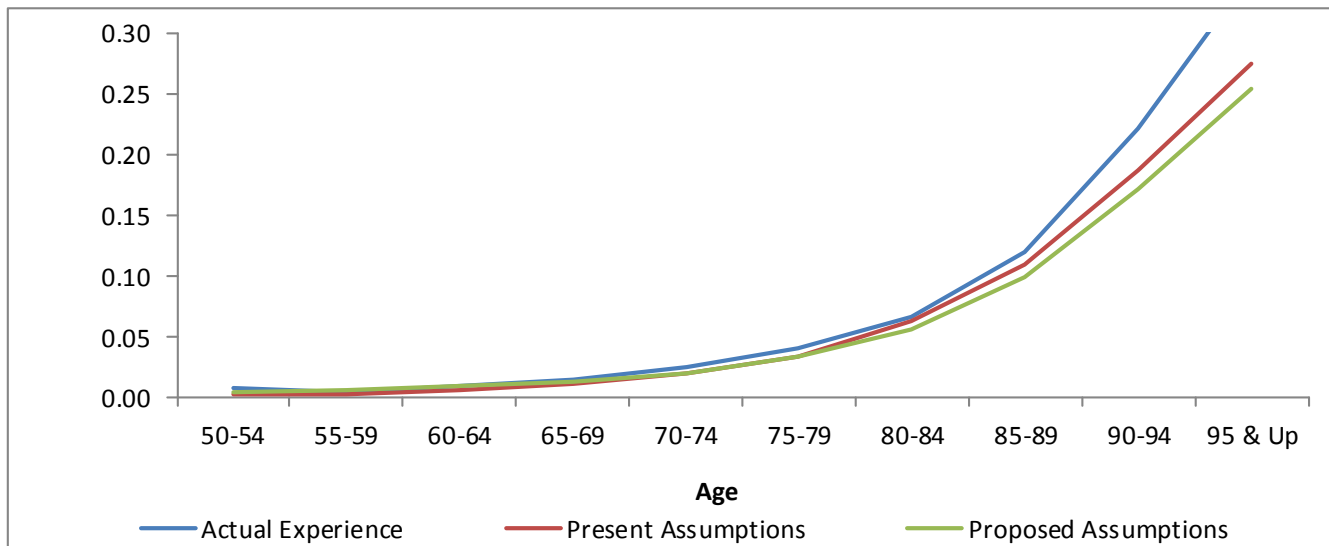
POST-RETIREMENT MORTALITY

Male Retired-Life Mortality Experience (Normal & Early Retirement, Original Annuitants Only)

Summary of Male Retired Lives Mortality Experience

There were 865 retired member deaths reported for the 5-year period and 27,000 life years of exposure included in the male retired-life mortality investigation.

Age	Life Years Exposure	Post-Retirement Death			Post-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
50-54	743	6	1	4	0.0081	0.00180	0.00456
55-59	3,123	15	10	20	0.0048	0.00314	0.00640
60-64	4,960	46	33	46	0.0093	0.00603	0.00921
65-69	5,598	80	65	75	0.0143	0.01169	0.01339
70-74	4,536	109	88	92	0.0240	0.01929	0.02026
75-79	3,569	146	121	118	0.0409	0.03365	0.03277
80-84	2,541	169	157	142	0.0665	0.06234	0.05616
85-89	1,407	168	153	136	0.1194	0.10974	0.09942
90-94	446	99	80	73	0.2220	0.18736	0.17086
95 & Up	77	27	20	19	0.3506	0.27496	0.25444
Totals	27,000	865	728	725	0.0320	0.02696	0.02685

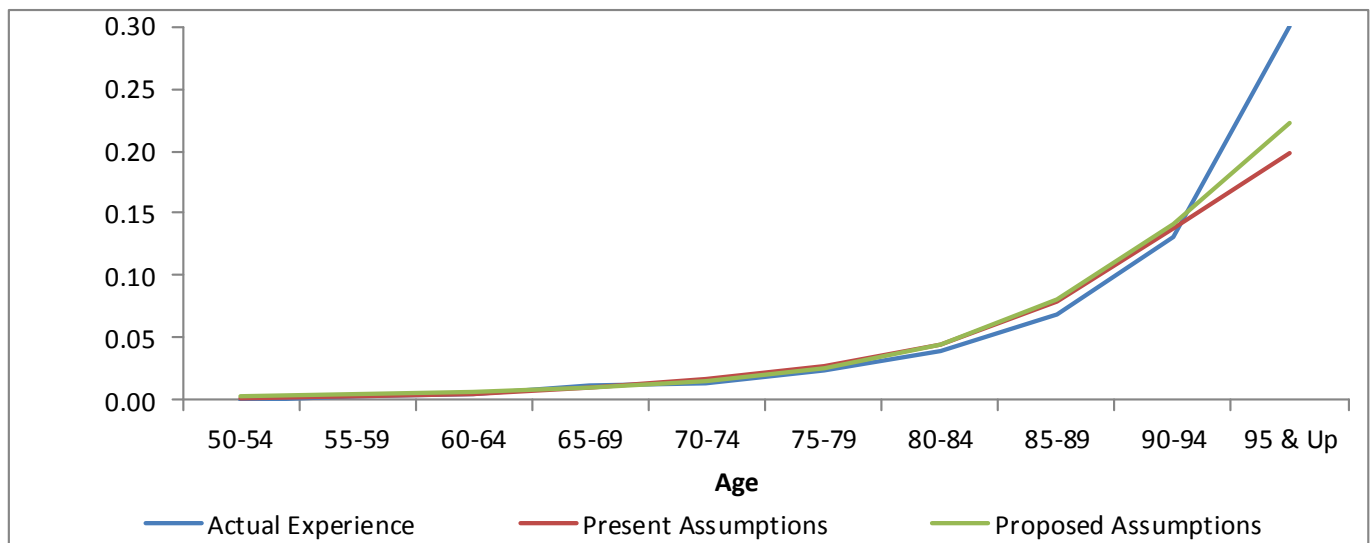


Female Retired-Life Mortality Experience (Normal & Early Retirement, Original Annuitants Only)

Summary of Female Retired Lives Mortality Experience

There were 61 retired member deaths reported for the 5-year period and 4,590 life years of exposure included in the female retired-life mortality investigation.

Age	Life Years Exposure	Post-Retirement Death			Post-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
50-54	162	-	1	1	0.0000	0.00143	0.00299
55-59	821	2	2	4	0.0024	0.00281	0.00441
60-64	1,240	6	7	8	0.0048	0.00537	0.00666
65-69	1,053	12	10	10	0.0114	0.01011	0.00985
70-74	583	8	10	9	0.0137	0.01687	0.01539
75-79	345	8	9	9	0.0232	0.02723	0.02554
80-84	228	9	10	10	0.0395	0.04538	0.04478
85-89	102	7	8	8	0.0686	0.07972	0.08105
90-94	46	6	6	6	0.1304	0.13782	0.14186
95 & Up	10	3	2	2	0.3000	0.19891	0.22234
Totals	4,590	61	65	67	0.0133	0.01416	0.01460

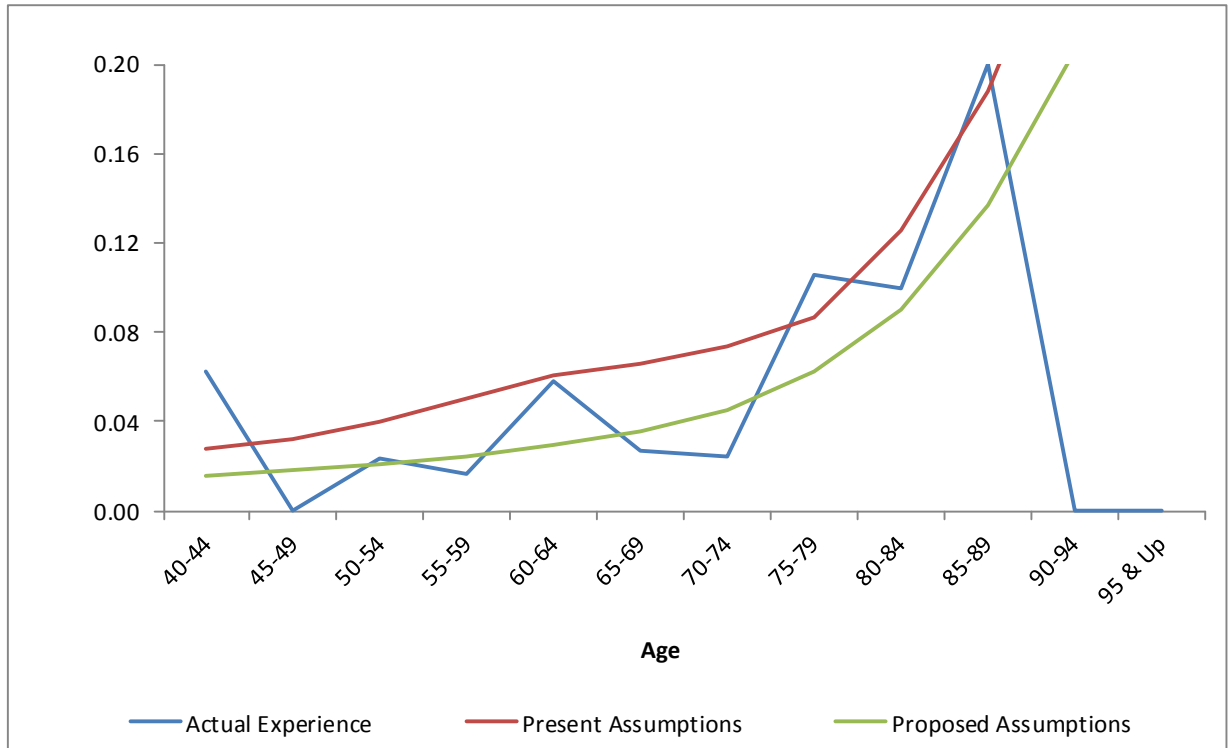


Male Disabled Mortality Experience

Disabled Male Deaths

There were 22 disabled retired male deaths reported for the 5-year period and 664 life years of exposure included in the male disabled mortality investigation.

Age	Life Years Exposure	Disabled-Retirement Death			Disabled-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
40-44	32	2	1	1	0.0625	0.02822	0.01545
45-49	58	-	2	1	0.0000	0.03230	0.01804
50-54	126	3	5	3	0.0238	0.03990	0.02095
55-59	178	3	9	4	0.0169	0.05045	0.02425
60-64	121	7	7	4	0.0579	0.06109	0.02944
65-69	74	2	5	3	0.0270	0.06622	0.03586
70-74	41	1	3	2	0.0244	0.07372	0.04544
75-79	19	2	2	1	0.1053	0.08626	0.06201
80-84	10	1	1	1	0.1000	0.12559	0.09015
85-89	5	1	1	1	0.2000	0.18810	0.13713
90-94	-	-	-	-	N/A	0.28234	0.20625
95 & Up	-	-	-	-	N/A	0.42351	0.27760
Totals	664	22	36	21	0.0331	0.05422	0.03163

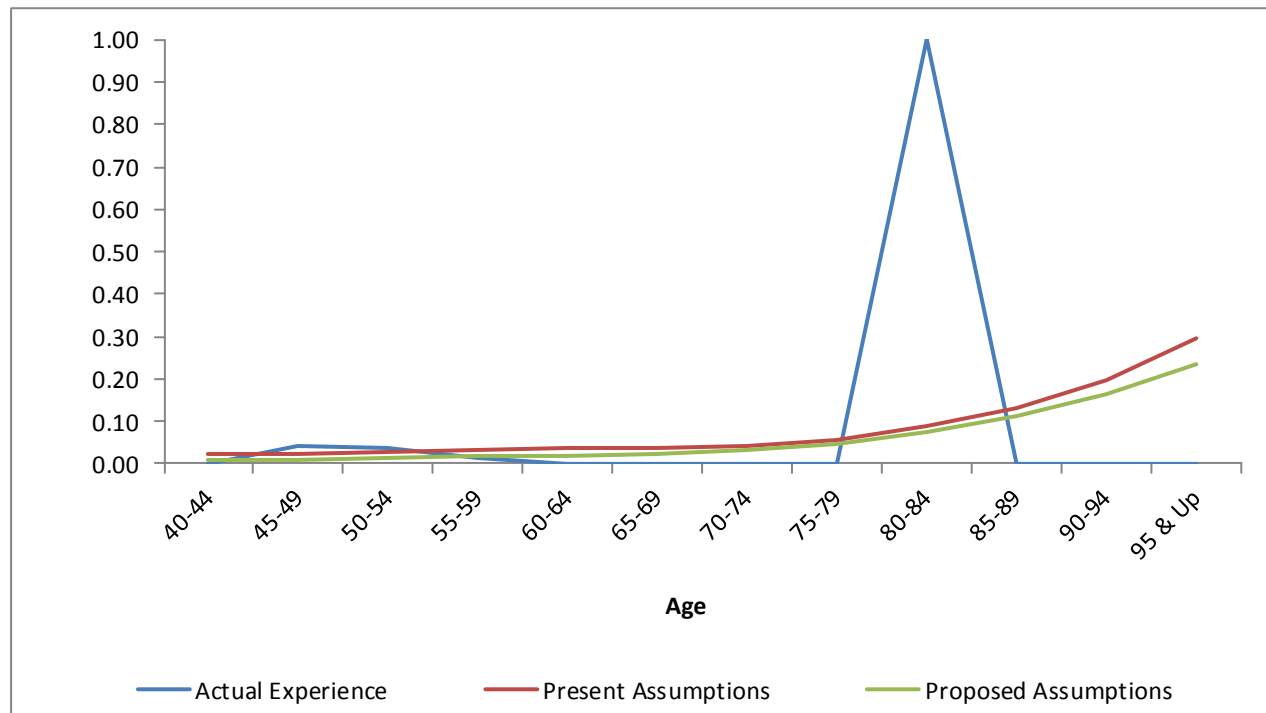


Female Disabled Mortality Experience

Disabled Female Deaths

There were 7 disabled retired female deaths reported for the 5-year period and 280 life years of exposure included in the female disabled mortality investigation.

Age	Life Years Exposure	Disabled-Retirement Death			Disabled-Retirement Death Rates		
		Actual Experience	Expected		Actual	Expected	
			Present	Proposed		Present	Proposed
40-44	11	-	-	-	0.0000	0.02130	0.00833
45-49	48	2	1	-	0.0417	0.02350	0.01008
50-54	82	3	2	1	0.0366	0.02720	0.01268
55-59	74	1	2	1	0.0135	0.03070	0.01649
60-64	47	-	2	1	0.0000	0.03470	0.01976
65-69	8	-	-	-	0.0000	0.03860	0.02366
70-74	7	-	-	-	0.0000	0.04330	0.03213
75-79	2	-	-	-	0.0000	0.05780	0.04805
80-84	1	1	-	-	1.0000	0.08850	0.07405
85-89	-	-	-	-	N/A	0.13220	0.11250
90-94	-	-	-	-	N/A	0.19800	0.16515
95 & Up	-	-	-	-	N/A	0.29720	0.23624
Totals	280	7	7	3	0.0250	0.02500	0.01071



SECTION F

ACTUARIAL METHODS AND MISCELLANEOUS AND TECHNICAL ASSUMPTIONS

Actuarial Methods

Actuarial Cost Method: The actuarial cost method is called the Entry Age Actuarial Cost Method. This method is consistent with the Board's level percent-of-payroll funding objective. With this method, the level percent-of-payroll is determined that will fund a member's retirement benefit over the member's entire working lifetime, from date of hire (Entry Age) to date of exit from the active member population. Differences in the past between assumed and actual experience become part of unfunded actuarial accrued liabilities and are amortized with level percent-of-payroll contributions. ***We recommend continued use of the entry age actuarial cost method.*** Note, this method is required in the Missouri Statutes.

Asset Valuation Method: The asset valuation method is a three-year smoothed market value method in which assumed investment return is recognized immediately each year and differences between actual and assumed investment return are phased-in over a closed three-year period. This asset valuation method is intended to give recognition to the long term accuracy of market values while filtering out and dampening short term market swings. ***We recommend continued use of the current asset valuation method.*** While we recommend the Board **consider** resetting the actuarial value of assets to the market value, given the recent market volatility, we are not making a hard recommendation to make this change.

Amortization Policy:

Permanent Policy: The total contribution will be based on normal cost plus an 18-year amortization of unfunded actuarial accrued liabilities. The amortization period is a closed 18-year period starting July 1, 2018.

Temporary Accelerated Policy: The total contribution is based on normal cost plus a 7-year amortization period for unfunded retiree liabilities and a 22-year amortization period for other unfunded liabilities. Both amortization periods are closed periods starting July 1, 2018.

This temporary accelerated policy was adopted by the Retirement Board on September 17, 2009 and will remain in effect until such time as the retiree liability becomes 100% funded or the permanent policy produces a higher contribution rate.

We recommend continued use of the current amortization policy.

Miscellaneous and Technical Assumptions

Administrative Expenses:	1.21% of payroll, based upon actual results from previous year.
Disability Expenses:	0.53% of payroll included in contribution. Retirement system pays premium directly to an outside insurance company or TPA.
Marriage Assumption:	90% of participants are assumed to be married for purposes of death-in-service benefits. Applies to disabled members entitled to future retirement benefits also. Male spouses are assumed to be 3 years older than females if beneficiary information is not available. For purposes of valuing the 50% death after retirement benefit, 100% of closed active members are assumed to be married.
Pay Increase Timing:	Beginning of (Fiscal) year. This is equivalent to assuming that reported pays represent amounts paid to members during the year ended on the valuation date.
Decrement Timing:	Decrements of all types are assumed to occur mid-year.
Eligibility Testing:	Eligibility for benefits is determined based upon the age nearest birthday and service nearest whole year on the date the decrement is assumed to occur.
Benefit Service:	Exact fractional service is used to determine the amount of benefit payable.
Decrement Relativity:	Decrement rates are used directly from the experience study, without adjustment for multiple decrement table effects.
Normal Form of Benefit:	The assumed normal form of benefit is a 50% joint & survivor benefit for married members in the Closed Plan and a straight life benefit for all other members.
Optional Benefit Factors:	Optional Benefit Factors are in accordance with tables adopted by the Board. We believe these factors are reasonably close to actuarial equivalence based on valuation assumptions. The reduction for the Y2K and 2011 Tier benefits was calculated in accordance with 104.1027 RSMo.
Deferred Plan Choice:	It was assumed that deferred members eligible for the Closed plan would choose the Closed plan benefits at retirement.
Other:	Turnover decrements do not operate during retirement eligibility.
Miscellaneous Adjustments:	The calculated normal and early retirement benefits for the Closed and Year 2000 plans were increased by 3.75% for Uniformed and 2.6% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. The calculated normal and early retirement benefits for the 2011 Tier plan were increased by 1.5% for Uniformed and 1.0% for Non-Uniformed to account for the inclusion of unused sick leave in the calculation of Average Pay. Post disability benefit liabilities were increased by 50% for all future disabilities to account for potential survivor benefits payable by the retirement system during the period of disability. Current self-insured disability retirant liabilities are increased by 12% to account for future survivor benefits. Liabilities for future deferred members were increased by 2% to account for potential survivor benefits payable if the member dies during the deferred period. The rationale for this load is based on the associated liabilities for the current deferred members.

Miscellaneous and Technical Assumptions

Contribution Stabilization Reserve Fund:	The contribution stabilization reserve fund affects the total amount of UAAL financed and is assumed to grow at the investment return rate.
Death Prior to Retirement:	100% of deaths in service are assumed to be non-duty.
Gainful Employment Offset:	30% of the \$90 per month special benefit is assumed to be offset by gainful employment.
Minimum Benefit Eligibility:	Deferred benefits and death prior to retirement benefits are assumed to be eligible for the minimum base benefit along with normal and early retirement benefits.
Active Plan Choice:	It was assumed that active members eligible for the Closed plan would choose the Closed plan benefits at retirement.
Member Contribution Interest:	Member contributions are assumed to be credited with 3.0% interest.

SECTION G

COMPREHENSIVE LISTING OF DEMOGRAPHIC ASSUMPTIONS

Actuarial Assumptions

Based on 2012-2017 Experience Study

Withdrawal Rates

Age	Service	% of Active Participants Withdrawing			
		Uniformed Members		Non-Uniformed Members	
		Male	Female	Male	Female
	0-1	12.00%	12.00%	30.00%	20.00%
	1-2	6.00%	6.00%	16.00%	14.00%
	2-3	2.50%	2.50%	9.00%	11.00%
	3-4	2.50%	2.50%	7.00%	9.00%
	4-5	2.50%	2.50%	5.50%	6.00%
25	5 & Up	1.89%	1.89%	5.60%	6.00%
26		1.89%	1.89%	5.60%	6.00%
27		1.89%	1.89%	5.60%	6.00%
28		1.89%	1.89%	5.60%	6.00%
29		1.89%	1.89%	5.60%	6.00%
30		1.89%	1.89%	5.60%	6.00%
31		1.89%	1.89%	5.53%	6.00%
32		1.83%	1.83%	5.46%	6.00%
33		1.65%	1.65%	5.39%	6.00%
34		1.49%	1.49%	5.32%	6.00%
35		1.34%	1.34%	5.25%	6.00%
36		1.19%	1.19%	5.18%	6.00%
37		1.06%	1.06%	5.11%	6.00%
38		0.95%	0.95%	5.04%	6.00%
39		0.86%	0.86%	4.97%	5.78%
40		0.79%	0.79%	4.90%	5.54%
41		0.74%	0.74%	4.48%	5.29%
42		0.69%	0.69%	4.06%	5.05%
43		0.64%	0.64%	3.64%	4.81%
44		0.60%	0.60%	3.22%	4.56%
45		0.55%	0.55%	2.80%	4.32%
46		0.50%	0.50%	2.66%	4.12%
47		0.46%	0.46%	2.52%	3.92%
48		0.41%	0.41%	2.38%	3.72%
49		0.36%	0.36%	2.24%	3.36%
50		0.32%	0.32%	2.10%	3.00%
51		0.27%	0.27%	1.96%	3.00%
52		0.23%	0.23%	1.82%	3.00%
53		0.21%	0.21%	1.68%	3.00%
54		0.19%	0.19%	1.54%	3.00%
55		0.16%	0.16%	1.40%	3.00%
56		0.17%	0.17%	1.40%	3.00%
57		0.13%	0.13%	1.40%	3.00%
58		0.13%	0.13%	1.40%	3.00%
59		0.13%	0.13%	1.40%	3.00%
60		0.12%	0.12%	1.40%	3.00%
Ref		1124	1124	852	1125
		1272	1272	60	1418
		70%	70%	70%	100%

Actuarial Assumptions

Based on 2012-2017 Experience Study

Disability Rates

Age	% of Active Participants Becoming Disabled			
	Uniformed Members		Non-Uniformed Members	
	Male	Female	Male	Female
20	0.10%	0.10%	0.06%	0.06%
21	0.10%	0.10%	0.06%	0.06%
22	0.10%	0.10%	0.07%	0.07%
23	0.10%	0.10%	0.07%	0.07%
24	0.10%	0.10%	0.07%	0.07%
25	0.10%	0.10%	0.08%	0.08%
26	0.10%	0.10%	0.08%	0.08%
27	0.10%	0.10%	0.09%	0.09%
28	0.10%	0.10%	0.09%	0.09%
29	0.10%	0.10%	0.09%	0.09%
30	0.10%	0.10%	0.10%	0.10%
31	0.10%	0.10%	0.10%	0.10%
32	0.10%	0.10%	0.11%	0.11%
33	0.10%	0.10%	0.11%	0.11%
34	0.10%	0.10%	0.12%	0.12%
35	0.10%	0.10%	0.13%	0.13%
36	0.10%	0.10%	0.13%	0.13%
37	0.10%	0.10%	0.14%	0.14%
38	0.10%	0.10%	0.14%	0.14%
39	0.10%	0.10%	0.15%	0.15%
40	0.10%	0.10%	0.17%	0.17%
41	0.10%	0.10%	0.19%	0.19%
42	0.10%	0.10%	0.21%	0.21%
43	0.10%	0.10%	0.23%	0.23%
44	0.10%	0.10%	0.24%	0.24%
45	0.10%	0.10%	0.27%	0.27%
46	0.10%	0.10%	0.30%	0.30%
47	0.10%	0.10%	0.32%	0.32%
48	0.10%	0.10%	0.36%	0.36%
49	0.10%	0.10%	0.41%	0.41%
50	0.10%	0.10%	0.46%	0.46%
51	0.10%	0.10%	0.52%	0.52%
52	0.10%	0.10%	0.59%	0.59%
53	0.10%	0.10%	0.68%	0.68%
54	0.10%	0.10%	0.77%	0.77%
55	0.10%	0.10%	0.86%	0.86%
56	0.10%	0.10%	0.97%	0.97%
57	0.10%	0.10%	1.09%	1.09%
58	0.10%	0.10%	1.22%	1.22%
59	0.10%	0.10%	1.35%	1.35%
60	0.10%	0.10%	1.49%	1.49%
61	0.10%	0.10%	1.64%	1.64%
62	0.10%	0.10%	1.80%	1.80%
63	0.10%	0.10%	1.97%	1.97%
64	0.10%	0.10%	2.15%	2.15%
65	0.10%	0.10%	0.00%	0.00%
66	0.10%	0.10%	0.00%	0.00%
67	0.10%	0.10%	0.00%	0.00%
68	0.10%	0.10%	0.00%	0.00%
69	0.10%	0.10%	0.00%	0.00%
70	0.10%	0.10%	0.00%	0.00%
71	0.10%	0.10%	0.00%	0.00%
72	0.10%	0.10%	0.00%	0.00%
Ref	60	60	189	189
Multiplier	20%	20%	90%	90%

Actuarial Assumptions Based on 2012-2017 Experience Study

Salary Scale – Service Based Rates

% Merit Increases in Salaries Next Year		
Service Index	Uniformed Members	Non-Uniformed Members
1	9.45%	6.80%
2	5.00%	4.50%
3	2.75%	2.80%
4	2.50%	1.50%
5	2.00%	1.00%
6	1.50%	0.80%
7	1.25%	0.00%
8	1.25%	0.00%
9	1.00%	0.00%
10	0.75%	0.00%
11	0.75%	0.00%
12	0.75%	0.00%
13	0.50%	0.00%
14	0.50%	0.00%
15	0.25%	0.00%
16	0.25%	0.00%
17	0.25%	0.00%
18	0.25%	0.00%
19	0.25%	0.00%
20	0.25%	0.00%
21	0.00%	0.00%
22	0.00%	0.00%
23	0.00%	0.00%
24	0.00%	0.00%
25	0.00%	0.00%
Ref	378	3

Actuarial Assumptions Based on 2012-2017 Experience Study

Normal and Early Retirement Pattern

Age	% of Active Participants Retiring								
	Closed and Year 2000 Plans					2011 Tier			
	Non-Uniformed Members				Uniformed	Non-Uniformed			Uniformed
	Male		Female			Normal		Early	
						Age & Service	Rule of 90		
Normal	Early	Normal	Early	Normal	Age & Service	Rule of 90	Early	Normal	
50	40%		25%		45%				
51	30%		20%		15%				
52	26%		20%		15%				
53	26%		20%		16%				
54	24%		24%		16%				
55	27%	3%	32%	3%	25%		30%		30%
56	25%	3%	35%	3%	30%		30%		30%
57	26%	4%	29%	4%	20%		30%		30%
58	22%	2%	25%	4%	30%		30%		30%
59	25%	4%	30%	5%	40%		30%		30%
60	19%	5%	22%	5%	100%		30%		100%
61	18%	5%	22%	5%	100%		30%		100%
62	40%	40%	36%	30%	100%		30%	10%	100%
63	35%	35%	22%	30%	100%		30%	10%	100%
64	25%	30%	20%	25%	100%		30%	10%	100%
65	35%		35%		100%		30%	10%	100%
66	40%		45%		100%		30%	10%	100%
67	45%		40%		100%	50%	30%		100%
68	30%		40%		100%	50%	30%		100%
69	30%		40%		100%	50%	30%		100%
70	40%		50%		100%	100%	100%		100%
71	50%		50%		100%	100%	100%		100%
72	50%		100%		100%	100%	100%		100%
73	50%		100%		100%	100%	100%		100%
74	100%		100%		100%	100%	100%		100%
Ref	2798	2799	2266	2800	2797	1873	1875	1262	1875
	50	55	50	55	50	67	55	62	45

Actuarial Assumptions Based on 2012-2017 Experience Study

Retired Lives Mortality Rates

Age	% Dying Next Year		Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female		Male	Female
20	0.0369%	0.0174%	60	0.7938%	0.5667%	100	31.3381%	28.0166%
21	0.0408%	0.0195%	61	0.8547%	0.6147%	101	33.3774%	30.0266%
22	0.0449%	0.0223%	62	0.9205%	0.6657%	102	35.3995%	32.0621%
23	0.0492%	0.0256%	63	0.9918%	0.7196%	103	37.3951%	34.0941%
24	0.0538%	0.0295%	64	1.0684%	0.7773%	104	39.3487%	36.0900%
25	0.0588%	0.0340%	65	1.1511%	0.8398%	105	41.2343%	38.0614%
26	0.0641%	0.0388%	66	1.2408%	0.9085%	106	43.0470%	39.9941%
27	0.0700%	0.0441%	67	1.3387%	0.9850%	107	44.7813%	41.8213%
28	0.0764%	0.0499%	68	1.4472%	1.0710%	108	46.4200%	43.5827%
29	0.0836%	0.0567%	69	1.5680%	1.1678%	109	47.9720%	45.2475%
30	0.0916%	0.0644%	70	1.7034%	1.2770%	110	49.4044%	46.8213%
31	0.1004%	0.0731%	71	1.8549%	1.4005%	111	49.9809%	48.2854%
32	0.1098%	0.0828%	72	2.0259%	1.5392%	112	49.9755%	49.6513%
33	0.1201%	0.0933%	73	2.2187%	1.6965%	113	49.9953%	50.2110%
34	0.1300%	0.1047%	74	2.4366%	1.8727%	114	49.9851%	50.0952%
35	0.1405%	0.1166%	75	2.6823%	2.0723%	115	50.0000%	50.0000%
36	0.1519%	0.1291%	76	2.9606%	2.2975%	116	50.0000%	50.0000%
37	0.1638%	0.1413%	77	3.2770%	2.5540%	117	50.0000%	50.0000%
38	0.1766%	0.1532%	78	3.6348%	2.8455%	118	50.0000%	50.0000%
39	0.1899%	0.1644%	79	4.0410%	3.1769%	119	50.0000%	50.0000%
40	0.2035%	0.1750%	80	4.5024%	3.5553%	120	100.0000%	100.0000%
41	0.2169%	0.1838%	81	5.0252%	3.9869%	Ref	2135 x 100%	2136 x 100%
42	0.2307%	0.1918%	82	5.6159%	4.4782%	Set Back	0	0
43	0.2453%	0.1994%	83	6.2866%	5.0381%	Proj. Scale	939	940
44	0.2609%	0.2070%	84	7.0474%	5.6722%	Base Year	2006	2006
45	0.2779%	0.2146%	85	7.9002%	6.3897%	Proj. Year	2022	2022
46	0.2964%	0.2231%	86	8.8634%	7.1988%			
47	0.3167%	0.2325%	87	9.9417%	8.1051%			
48	0.3394%	0.2424%	88	11.1427%	9.1109%			
49	0.3644%	0.2533%	89	12.4767%	10.2194%			
50	0.3922%	0.2660%	90	13.9500%	11.4522%			
51	0.4231%	0.2806%	91	15.4968%	12.7799%			
52	0.4563%	0.2986%	92	17.0856%	14.1857%			
53	0.4885%	0.3200%	93	18.6789%	15.6544%			
54	0.5223%	0.3449%	94	20.2575%	17.1685%			
55	0.5582%	0.3734%	95	21.8007%	18.7264%			
56	0.5971%	0.4054%	96	23.6045%	20.4458%			
57	0.6398%	0.4409%	97	25.4442%	22.2335%			
58	0.6865%	0.4797%	98	27.3578%	24.1013%			
59	0.7377%	0.5218%	99	29.3232%	26.0345%			

Actuarial Assumptions Based on 2012-2017 Experience Study

Death-in-Service Rates

Age	% Dying Next Year		Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female		Male	Female
20	0.0239%	0.0106%	60	0.3113%	0.1733%	100	20.3698%	18.2108%
21	0.0268%	0.0108%	61	0.3515%	0.1870%	101	21.6953%	19.5173%
22	0.0295%	0.0109%	62	0.3965%	0.2013%	102	23.0097%	20.8404%
23	0.0313%	0.0112%	63	0.4467%	0.2166%	103	24.3068%	22.1612%
24	0.0324%	0.0116%	64	0.5019%	0.2329%	104	25.5767%	23.4585%
25	0.0309%	0.0119%	65	0.5624%	0.2506%	105	26.8023%	24.7399%
26	0.0302%	0.0122%	66	0.6210%	0.2753%	106	27.9806%	25.9962%
27	0.0300%	0.0127%	67	0.6844%	0.3028%	107	29.1078%	27.1838%
28	0.0303%	0.0133%	68	0.7539%	0.3335%	108	30.1730%	28.3288%
29	0.0311%	0.0140%	69	0.8303%	0.3680%	109	31.1818%	29.4109%
30	0.0322%	0.0150%	70	0.9147%	0.4070%	110	32.1129%	30.4338%
31	0.0337%	0.0161%	71	1.0083%	0.4510%	111	32.4876%	31.3855%
32	0.0352%	0.0174%	72	1.1130%	0.5006%	112	32.4841%	32.2733%
33	0.0368%	0.0187%	73	1.2299%	0.5572%	113	32.4969%	32.6372%
34	0.0382%	0.0200%	74	1.3608%	0.6207%	114	32.4903%	32.5619%
35	0.0393%	0.0214%	75	1.5071%	0.6928%	115	32.5000%	32.5000%
36	0.0402%	0.0227%	76	1.6706%	0.7741%	116	32.5000%	32.5000%
37	0.0412%	0.0242%	77	1.8540%	0.8664%	117	32.5000%	32.5000%
38	0.0423%	0.0258%	78	2.0582%	0.9704%	118	32.5000%	32.5000%
39	0.0437%	0.0276%	79	2.2859%	1.0874%	119	32.5000%	32.5000%
40	0.0456%	0.0296%	80	2.5398%	1.2190%	120	100.0000%	100.0000%
41	0.0478%	0.0317%	81	2.8770%	1.4450%	Ref	2133 x 65%	2134 x 65%
42	0.0506%	0.0340%	82	3.2941%	1.7633%	Set Back	0	0
43	0.0543%	0.0367%	83	3.7903%	2.1715%	Proj. Scale	939	940
44	0.0588%	0.0398%	84	4.3640%	2.6658%	Base Year	2006	2006
45	0.0640%	0.0434%	85	5.0073%	3.2435%	Proj. Year	2022	2022
46	0.0705%	0.0474%	86	5.7229%	3.9007%			
47	0.0777%	0.0521%	87	6.5034%	4.6310%			
48	0.0860%	0.0571%	88	7.3429%	5.4253%			
49	0.0954%	0.0626%	89	8.2360%	6.2734%			
50	0.1058%	0.0688%	90	9.1736%	7.1761%			
51	0.1174%	0.0757%	91	10.1429%	8.1223%			
52	0.1305%	0.0835%	92	11.1417%	9.1047%			
53	0.1442%	0.0922%	93	12.1542%	10.1144%			
54	0.1594%	0.1017%	94	13.1696%	11.1381%			
55	0.1764%	0.1121%	95	14.1705%	12.1722%			
56	0.1960%	0.1233%	96	15.3429%	13.2898%			
57	0.2187%	0.1351%	97	16.5387%	14.4518%			
58	0.2452%	0.1474%	98	17.7826%	15.6658%			
59	0.2759%	0.1602%	99	19.0601%	16.9224%			

Actuarial Assumptions

Based on 2012-2017 Experience Study

Disabled Retired Lives Mortality Rates

Age	% Dying Next Year		Age	% Dying Next Year		Age	% Dying Next Year	
	Male	Female		Male	Female		Male	Female
20	0.0438%	0.0203%	60	2.7176%	1.8560%	100	32.6085%	28.7749%
21	0.0612%	0.0284%	61	2.8283%	1.9166%	101	34.2769%	30.5690%
22	0.0856%	0.0397%	62	2.9435%	1.9759%	102	35.9695%	32.4095%
23	0.1168%	0.0547%	63	3.0631%	2.0367%	103	37.6945%	34.2784%
24	0.1553%	0.0728%	64	3.1849%	2.1023%	104	39.4530%	36.1549%
25	0.2005%	0.0940%	65	3.3118%	2.1768%	105	41.2343%	38.0614%
26	0.2533%	0.1174%	66	3.4447%	2.2633%	106	43.0470%	39.9941%
27	0.3130%	0.1436%	67	3.5855%	2.3662%	107	44.7813%	41.8213%
28	0.3801%	0.1725%	68	3.7399%	2.4882%	108	46.4200%	43.5827%
29	0.4543%	0.2051%	69	3.9098%	2.6317%	109	47.9720%	45.2475%
30	0.5358%	0.2419%	70	4.0984%	2.7988%	110	49.4044%	46.8213%
31	0.6235%	0.2828%	71	4.3081%	2.9925%	111	49.9809%	48.2854%
32	0.7158%	0.3281%	72	4.5436%	3.2128%	112	49.9755%	49.6513%
33	0.8114%	0.3776%	73	4.8065%	3.4648%	113	49.9953%	50.2110%
34	0.9026%	0.4306%	74	5.1008%	3.7463%	114	49.9851%	50.0952%
35	0.9943%	0.4864%	75	5.4281%	4.0624%	115	50.0000%	50.0000%
36	1.0858%	0.5436%	76	5.7929%	4.4139%	116	50.0000%	50.0000%
37	1.1751%	0.6006%	77	6.2011%	4.8052%	117	50.0000%	50.0000%
38	1.2617%	0.6557%	78	6.6529%	5.2368%	118	50.0000%	50.0000%
39	1.3443%	0.7078%	79	7.1550%	5.7097%	119	50.0000%	50.0000%
40	1.4204%	0.7560%	80	7.7133%	6.2278%	120	100.0000%	100.0000%
41	1.4852%	0.7965%	81	8.3320%	6.7925%	Ref	2137 x 100%	2138 x 100%
42	1.5449%	0.8333%	82	9.0153%	7.4046%	Set Back	0	0
43	1.6000%	0.8677%	83	9.7759%	8.0682%	Proj. Scale	939	940
44	1.6518%	0.9006%	84	10.6221%	8.7816%	Base Year	2006	2006
45	1.7022%	0.9338%	85	11.5504%	9.5490%	Proj. Year	2022	2022
46	1.7528%	0.9691%	86	12.5809%	10.3728%			
47	1.8036%	1.0081%	87	13.7130%	11.2504%			
48	1.8561%	1.0486%	88	14.9503%	12.1767%			
49	1.9108%	1.0931%	89	16.2983%	13.1470%			
50	1.9679%	1.1445%	90	17.7578%	14.1809%			
51	2.0285%	1.2025%	91	19.1980%	15.3068%			
52	2.0949%	1.2677%	92	20.6246%	16.5148%			
53	2.1519%	1.3387%	93	22.0177%	17.7919%			
54	2.2110%	1.4144%	94	23.3675%	19.1177%			
55	2.2745%	1.4929%	95	24.6544%	20.4885%			
56	2.3451%	1.5721%	96	26.2066%	22.0265%			
57	2.4253%	1.6494%	97	27.7603%	23.6241%			
58	2.5146%	1.7227%	98	29.3541%	25.2910%			
59	2.6124%	1.7921%	99	30.9669%	27.0120%			

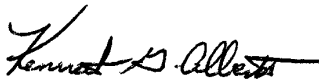
February 6, 2018

Mr. Scott Simon
Executive Director
Missouri Department of Transportation and
Highway Patrol Employees' Retirement System
1913 William Street
Jefferson City, MO 65109

Dear Scott:

Please find enclosed 15 copies of the MPERS Experience Study for the period July 1, 2012 through June 30, 2017.

Sincerely,


Kenneth G. Alberts

KGA:sc
Enclosures